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Gender, Graduate School, and the Geosciences

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Gender, Graduate School, and the Geosciences

by

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Dedication

To my two best friends in the world: my husband and my big brother. I would never have gotten to where I am today without you. To my mom and dad, for their unconditional love and support. To my in-laws, for accepting a non-engineer into their midst with open arms. Finally, to Ranger and Charlie, for faithfully resting at my feet during the many hours spent writing and revising this thesis and for providing unscheduled bursts of amusement to ease the stress of being in the liminal state between student and scholar.

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Abstract

Gender, Graduate School, and the Geosciences

By

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The University of Texas at Austin, 2011

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I explore how gender operates to disadvantage women graduate students in the geosciences. My study is framed and supported by three veins of theory which provide insight into how gender operates in often invisible ways to marginalize and exclude women scientists: Joan Acker's theory of gendered organizations, theory regarding the process of socialization into graduate school, and feminist theory regarding the relationship between women and the sciences. While women vary in the extent to which they see gender bias as impacting their experience in graduate school, there are invisible ways in which gender bias operates to disadvantage women. For example, the expectation held by elite graduate programs that students should avoid taking on responsibilities outside the classroom and lab marginalizes women who have or are interested in having partners or children; due to cultural understandings about what a father's role in the family should be, the same does not hold true for men. Disadvantages experienced in graduate school may impact women later on in their careers and ultimately lead them to exit the field. I suggest that current messages about the field of geosciences, and the oil & gas industry in particular, may strip women (and men) of a feminist platform from which to combat gender inequality.

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Chapter 1. Introduction

"A woman's place is in the cave?"

A few months ago I attended a meeting of leaders in government, education, and industry to gather background information for writing this thesis, which examines how gender shapes students', and especially women's, experiences of graduate education in the geosciences and their career plans as professional geoscientists. The purpose of the meeting was to develop solutions for increasing the size of the North American geoscience workforce. The presentations covered a number of topics, from programs designed to get more young people interested in science to the recruitment issues facing oil & gas companies drilling in the Bakken Shale. During the Q&A session that followed a presentation on the global petrotechnical workforce, an audience member asked for statistics on the status of women and minorities. This sparked a lively debate among the audience members about why there were so few American women in the geoscience workforce. At one point, a woman chimed in that in Thailand the geoscientists tend to be women. "A woman's place is in *the cave?*" responded a male audience member, his voice laden with humor and irony. Many people in the room responded in laughter, though some audience members looked more genuinely amused than others.

"A woman's place is in the cave" is a direct and obvious reference to the adage, "A woman's place is in the home," variations of which can be traced all the way back to a play written by the Greek poet Aeschylus in 467 B.C. (Martin n.d.). Today, this saying references the family arrangement most typical to middle and upper class whites in the industrial period, in which men spent their days in the public sphere as paid laborers, while women stayed home to cook, clean, and to raise children, perhaps taking in paid work, like laundry, on the side (Thistle 2006).

Today, many women spend their days (or nights) outside their own homes. A total of 72 million women, or about 60 percent of women aged 16 and older, participate in the official labor force (Bureau of Labor Statistics 2009). However, many women's paid work looks very similar to their unpaid work (Thistle 2006). Women are overly represented in occupations that require "care work," like nursing, teaching, childcare, and

housekeeping, much of which takes place in other people's homes. In fact, at least half of the "20 most prevalent occupations for employed women" (BLS 2009) involve significant levels of care work. Many women, including those whom are professional scientists, leave their paid work to return to their families where a "second shift" of unremunerated care work ensues (Hochschild & Manchung 1990; Schiebinger & Gilmartin 2010). Schiebinger (1999) argues that even when people hire outside help like nannies or housecleaners to reduce their responsibilities at home, they must still hire, train, and oversee these workers, a time-intensive task that unduly falls on women (98). A significant portion of women leave the workforce at some point during their careers because their job and/or workplace is not flexible enough to enable them to meet the demands of raising children concurrently with the demands of their jobs (Hewlett, Sherbin & Foster 2010; Hewlett & Luce 2005), and those who do not leave are often penalized for attempting to juggle the care work required in raising children with their paid labor (Ridgeway & Correll 2004; Correll, Bernard, Paik 2004; Budig & England 2001).

The male audience member's remark reminds us of the tenuous position of women geoscientists. First, women geoscientists are attempting to enter a field (the geosciences) and space ("the cave," fieldsite, or oil rig) that have long been marked as "masculine," placing them at risk of facing overt discrimination and hostility (see, for example, Kanter 1977, Yoder 2001). Second, they must negotiate the tenuous boundaries of "being a mother and a scientist," as one of my respondents so astutely noted, or more broadly, a woman, with all its remaining expectations of domesticity, and a scientist, a career still assumed to be the domain of men (e.g., Finson 2000).

The number of women who are trained as geoscientists is growing. In 1970, women earned fewer than 15 percent of bachelor's degrees, ten percent of master's degrees, and around 5 percent of PhDs granted in the field (Kauffman 1987 in Crawford, Moody, & Tullis 1987). By 1990, women earned 30 percent of bachelor's degrees, around a quarter of master's degrees, and a fifth of doctorate degrees in the geosciences in the U.S (Gonzales 2009, no. 27). Currently, women earn roughly 40 percent of all geoscience degrees, with no great disparities between women's earning rates at the bachelor's, master's, and PhD-levels (Gonzales & Keane 2011). The geosciences are the

only physical science to have achieved near gender-parity in number of higher-level degrees awarded (National Science Foundation (NSF) 2007).

However, anecdotal information gathered in interviews by sociologists Christine Williams and Chandra Muller (not yet published) and several informal surveys suggest that women may be more likely to attrite from the geoscience workforce than men, (e.g., Sprunt 2006, Holmes et al. 2003; note these studies focus on the oil & gas industry and academia, not the government, another large employer of geoscientists), likely partially driven by the challenges mentioned above. While studying the processes that act to push women out of the geoscience workforce is important (and for example, is the current undertaking of Williams and Muller, who are studying women's experiences in the oil & gas industry), so too is developing an understanding what happens to women geoscientists *before* they enter the workforce.

If women have already had many negative experiences in the geosciences prior to joining the geoscience workforce, these may snowball by the time women reach the workforce and result in a decision to exit the field (Etzkowitz, Kemelgor, & Uzzi 2000). Similarly, if women have positive experiences throughout their education, they may enter the workforce unprepared to face barriers to their success in the field. Caught off guard, they may exit the field. While these hypotheses make intuitive sense, they have yet to be studied thoroughly. In this thesis, I add to an understanding of the processes that may work to exclude and marginalize women, while reaffirming and supporting men, in graduate school in the geosciences—processes that may contribute to women's exit later down the line. Graduate school is more than just a "box to be checked," but orients men and women toward their future career, for example, providing them with the professional contacts (networks), training, and knowledge of the field to be successful (Austin 2002, Etzkowitz, Kemelgor, & Uzzi 2000). Thus, graduate school is essential to preparing people for the challenges they will face in the workforce, as it allows them to dip their feet into the profession, while (ideally) providing them with support as they grapple with socialization into the methods and inner-workings of the field. Since graduate school is considered a prerequisite for even an entry-level job into the geosciences, it is the perfect place to study how gender may operate to disadvantage (some) women prior to even entering the professional workforce.

This thesis is multi-part. First, I examine how men and women formed their interest in the geosciences, their motivation to attend graduate school, and the choices that went into selecting a geoscience program. This background is necessary for understanding students' current relationship to, and experiences within the, field as a graduate student. Next, I examine men and women's graduate school experiences in the geosciences, examining the types and quality of relationships formed with other graduate students and professors, relationships which are important for students' social, psychological, and professional well-being in graduate school and beyond. Previous research has established the importance of networks to success as a scientist (Etzkowitz, Kemelgor, & Uzzi 2000). I also examine instances of overt bias against women in graduate school in the geosciences, which may hinder their success in graduate school or prevent them achieving their full potential later in their careers. Finally, I examine the messages that men and women receive about the careers available to them as geoscientists. I ask how gender helps to shape these perceptions, and how they play into men and women's future career plans. I ask, for instance, how women's perceptions of the gendered challenges they will face shape their career aspirations. Before discussing my results however, I discuss the theoretical considerations that help shape and frame this study, my methods for exploring these areas of interest, and provide a review of relevant literature.

Theory

I argue that graduate school is more than a box to be checked but helps shape students' perceptions of the field, which in turn, affects their concrete decisions about working in the field, as well as their preparation as future workers, in the forms of knowledge, experience, and contacts. This idea is largely influenced by Henry Etzkowitz, Carol Kemelgor, and Brian Uzzi's (2000) work on women in the sciences, *Athena Unbound,* as well as Ann E. Austin's research (2002). Using qualitative data, collected longitudinally from a group of graduate students, Austin explored "doctoral education as socialization for the professoriate," asking whether or not the type of socialization students received matched up with the realities of the workforce they were about to enter (95). Austin conceptualizes the socialization process as both dynamic and multi-faceted.

Summing several other researchers work, she concludes that "graduate students experience several socialization processes simultaneously: socialization to the role of graduate student, socialization to the academic life and the profession, and socialization to a specific discipline or field" (Austin 2002). She examines how "graduate student development, socialization, and preparation" work; "the processes, influences, and interactions that graduate students use to make sense of their experiences and prepare for the professoriate"; and finally, their "conceptions and perceptions of the academic career and faculty work." While innovative, Austin's study does not consider the role of gender in impacting the socialization process or the role of graduate school in socializing or orienting one to a non-academic career. In addition, Austin did not focus specifically on graduate school in the geosciences, but rather, interviewed students from across the sciences, humanities, social sciences, and professional studies. Given that graduate education in the sciences is organized substantially differently than graduate school in these other fields (for example, programs tend to be organized by labs), it is important to consider these differences.

Etzkowitz, Kemelgor, and Uzzi (2000) conducted more than 400 interviews of women scientists at various stages in their careers, examining the barriers women faced in graduate school and in work. In their book, Etzkowitz and colleagues (2000) introduced the concept of "cumulative disadvantage" to suggest that although the challenges that women face may not be overwhelming or appear to have an impact immediately, overtime, they may "accumulate" to cause significant disadvantage in their careers compared to men, and may, in more extreme cases, press them to leave the field. In other words, little nicks in women's armor, caused for example, by a discriminatory boss or an unfriendly research team, leave women more vulnerable later on in their careers (Etzkowitz, Kemelgor, & Uzzi 2000). Thus, while women may complete graduate school, they may never join the workforce, or may leave after being faced with one (or two and so on) more barrier(s).

Although graduate school in the geosciences has reached statistical parity in the number of male and female students, this does not negate the need to consider how graduate school may contribute to women's "cumulative disadvantage" in the sciences. There are three lines of theory to suggest that gender is important to shaping the graduate

student experience and may work to disadvantage women over men (although race, class, and other factors, also matter, as gender intersects with these master characteristics (Collins 2000)): 1) Joan Acker's (1990) theory of gendered organizations, 2) research regarding socialization into graduate school, and 3) feminist theories regarding women's relationship to the sciences.

Gendered organizations

Joan Acker's theory of gendered organizations was a response to Kanter's (1977) famous book, *Men and Women of the Corporation.* Kanter documented the challenges faced by women as they entered male-dominated organizations. For example, these "female tokens" faced isolation, stigmatization, and performance pressure as lone, or one of a small group of, women. Kanter suggested that once women reached "critical mass*"* in an organization these problems would largely dissipate and that gender parity would increase at all levels of the organization.

For years, increasing the number of women in male-dominated fields (done, for example, by pressing for increased access to educational opportunities for women and fairer hiring practices) was one of the main goals of the feminist enterprise. Although this movement has been extremely successful, for the most part, the changes to gender equality in work organizations that Kanter predicted simply did not follow women's mass exodus from the "home to the marketplace" (Thistle 2006). Increasing the number of women in an organization or field often does help to diminish the feelings of isolation and stigmatization "token" women report (Kanter 1977). However, depending on the structure of an organization or field, such as the sciences, where women might be isolated within labs, adding more women may not reduce the effects of tokenism (Etzkowitz, Kemelgor, & Uzzi 2000). Similarly, because women are not a monolithic group, lack of shared interests or goals may prevent them from interaction, or from joining together to press for organizational change, such as achieving equality at the highest levels of an organization (Etzkowitz, Kemelgor, & Uzzi 2000, see also Schiebinger 1999).

Research suggests that even when women comprise the statistical majority within an organization or field, they often experience gender bias. In fact, some researchers have suggested that after a certain "tipping point" in the percentage of women within an

occupation, the field begins to lose prestige: For example, England and Li (2006) found that as women increased their proportion in some college majors, "men eschewed these fields." Women-dominated occupations are often low in status and pay, and women's segregation into low paid occupations is one of the primary explanations for the significant disparity in men and women's compensation. Christine Williams' (1995) work demonstrates the persistency of male dominance in female-majority organizations. She showed that, rather than suffer, men tend to benefit from their token status in female-dominated organizations, riding a "glass escalator" to positions with higher pay, prestige, and power. However, race does matter in determining which males benefit from tokenism (Wingfield 2009). In addition, Kristen Schilt's (2006) work suggests that female-to-male transgender people (FTMs) often benefit from their new status as "man" in the workplace; however, race and height of the FTMs as well as level of organizational acceptance of those who made non-stealth transitions had mediating effects.

Acker's (1990) theory of gendered organizations helps to explain why women, on average, do not fare as well in the workplace as men, for example, why very few women rise to the top of an organization and women tend to be over-represented in the lowest organizational rungs (Catalyst 2011, Baron, Davis-Blake, & Bielby, 1986). It explains why women do less well than men even in organizations where there is little overt discrimination against women and women have reached "critical mass." Acker demonstrated that gender bias is often built into the very structure of jobs and workplaces. According to Acker, "gender is implicated in the fundamental, ongoing processes of creating and conceptualizing social structures" (146). Ideas about gender are written into rules, contracts, job descriptions, job evaluations, and job hierarchies, all "constitutive elements of organizational logic" (147). For example, in business, certain types of leadership are more valued and rewarded (via accolades, pay raises, promotions) than others (Appelbaum, Audet, & Miller 2003). Often, these are the styles of leadership that men, but not women, have been socialized to perform (Appelbaum, Audet, & Miller 2003). However, women who perform these leadership styles do not benefit in the same way as men, rather they may face retribution or penalization for breaking gender norms (Carli & Eagly 2001; Eagly & Karau 2002). Thus, in this case, organizational logic and

stereotypes and attitudes about appropriate gender performance work together to inhibit women's opportunities for promotion to positions of leadership.

According to Acker, even jobs themselves are gendered. Jobs are built around a "disembodied worker" with no needs or responsibilities outside the workplace. The disembodied worker is, of course, mythical: All human beings have needs they must fulfill outside of the workplace. Men, as a group, however, come closest to this ideal: "The closest the disembodied worker doing the abstract job comes to a real worker is the male worker whose life centers on his full-time, life-long job, while his wife or another woman takes care of his personal needs and his children" (Acker 1990, 149). Because women tend to be the primary caregivers and are often (though not necessarily, given the availability of adoption and the use of surrogate mothers by some families) the physical carriers of children, they are more likely, as a group, to allow outside needs to "impinge" on workplace needs (Acker 1990).

Acker's theory explains why some women are able to rise higher within an organization than others. Women whose lifestyles resemble men's (childless women or women who hire a full-time nanny and/or housekeeper, essentially, a for-hire "wife"), tend to fare relatively well in workplaces, leading some to argue that motherhood, more so than gender, results in discrimination against women in the paid labor force (Ridgeway & Correll 2004; Correll, Bernard, Paik 2004). However, even these women have a hard time breaking into the highest level of organizations, because they lack the intangible qualities (masculine traits embodied in a man's body) typically valued in leaders (Appelbaum, Audet, & Miller 2003; Eagly & Karau 2002) and may suffer from isolation and stigmatization as "tokens," that they may not have experienced at lower organizational rungs.

Although Acker's theory of gendered organizations is typically applied to work organizations, it can be used as a valuable tool for gaining insight into how elite graduate programs operate. Elite graduate programs are, in many ways, similar to work organizations. For one, they assume a "disembodied student," that is a student who is free from family or outside work obligations that would inhibit him or her from accomplishing the many demands placed on and expectations of graduate students in these programs. For example, many elite graduate programs discourage, and some even

prohibit, students from accepting outside jobs if they are receiving university and/or departmental funding.

Acker's modified theory suggests that in order for women to be well received in graduate school, they should avoid marriage, and especially, having children. Available evidence suggests that women who attend graduate school do delay having children (Clune, Nuñez & Choy 2001). It may be that women who attend graduate school privilege career development over having children during that stage of their life. Sax (2001) suggested that desire to "raise a family," along with other factors, contributes to women's decision not to pursue graduate education in science, math, or engineering. Thus, women who privilege children may "opt out" of attending graduate school in the first place, perhaps in recognition of the difficulty of balancing both.

Several research studies have captured the difficulty women who want to or choose to get married and/or have children face in graduate school (Etzkowitz, Kemelgor, Neuschatz, & Uzzi 1994; see also Etzkowitz, Kemelgor, & Uzzi 2000). Mason and colleagues found that women who had "early" babies tend to leave academia, and that the majority of the women who succeed in academia do not have any children (Mason 2006). Having children does not have the same negative impact on most men in graduate school (Masson 2006), who, following gendered expectations are less likely to be as involved of parents as women.

There is a chance that the situation for women who want to have children in graduate school may have improved somewhat in the last decade, but that this has not yet been captured in research. (Many of these studies rely on data that are now a decade or more older). For example, there may be changing norms about having children in graduate school, or policies that have been introduced to account for the fact that women (and men) may wish to have children during graduate school. In other words, the expectations of what it means to be a graduate student may have changed in some departments. Indeed, there are signs of positive structural changes such as Princeton's initiation of family-friendly graduate package that provides paid maternity leave, extensions of academic deadlines and fellowship dates after childbirth, childcare support of up to $10,000 per year, and funding for childcare when parents need to travel for research and back-up childcare when their regular childcare services are not available

(Jaschik 2007). The acceptance around taking advantage of these policies is unknown: It is possible that women who have children and take advantage of these policies may be discreetly "mommy-tracked."

Acker's theory of gendered organizations also provides a framework for considering other ways the "job description" of graduate students has implicitly assumed that the people filling said job are men. To understand how this works for graduate students, I turn to the literature of socialization into graduate school as well as academia, more generally. I argue that women may have a more difficult time adjusting to implicit expectations of graduate students, due to gender socialization and the "double bind."

Socialization into graduate school and the potential difficulties for women

Some researchers have questioned how the socialization process that occurs in graduate school might work to disadvantage or disenfranchise women and/or minorities (e.g., Etzkowitz, Kemelgor, & Uzzi 2000; Beoku-Betts 2004; Rios 2010). These researchers acknowledge the history of the academy as a male-enclave and the masculine norms used to define success as a graduate student.

For example, Rios (2010) suggests that expectations of graduate students are premised on types of behaviors, attitudes, and actions which men, more so than women, have received prior socialization to perform:

> The academy's historical roots as a middle and upper class white male institution have resulted in a set of norms by which all graduate students and faculty are socialized, such as maintaining an appearance of self-control at all times, privileging of intellectual engagement over utility, and a style of verbal engagement that may seem hostile to some. These norms may not be easily adopted by members of some groups because of different cultural or gender norms. (66).

Rios suggests the standards used to assess the performance of graduate students are implicitly biased against many women and non-white men, whom may have a harder time learning and adopting to the norms of academia, and may experience a loss of identity during this process (Rios 2010). Even if these students perform well on the "official" tasks on which they are evaluated (for example, they perform well on coursework, make valuable contributions in class, write a theoretically interesting and

engaging master's thesis, and pass the comprehensive exams), they may be penalized for not meeting the unwritten rules of academia (Etzkowitz, Kemelgor, & Uzzi 2000; Rios 2010) or by not making connections to those who will helpful in furthering their careers.

If being an academic does not come as easily to (some) women and minorities as to (most) white men then they will be reliant on graduate students and faculty members to patiently introduce them into the norms of academia. However, research has suggested that these groups might not always have access to this sort of collaboration and mentorship (Etzkowitz, Kemelgor, & Uzzi 2000; Beoku-Betts 2004; Schwartz et al. 2003).

Women who are willing and able to accommodate to masculine norms of academia, however, are caught in a double bind. Even if women learn and adopt the unwritten expectations of what it means to be an academic, they will not typically be read the same way as a male with these traits (J.C. Williams 2006). For example, a woman graduate student who learns to aggressively defend her ideas and methods may be considered non-gender normative by others and might be penalized by other students and faculty as a result.

Science as exclusionary of women

A third line of research suggests that the practice of science itself may work to exclude women. Generally, the sciences are considered male-dominated, masculine-identified fields. Sciences with a high female presence (such as biology) have become so more recently in history, and women are still underrepresented as PhDs in all but one S&E field and as tenured faculty in all S&E fields (NSF 2007, NRC 2010).

However, is incorrect to think that science has always been the sole domain of men. Today's lack of women in the sciences is a result of a complex set of processes that occurred in the late 19th century/early 20th century in Western countries such as the United States and Britain. Schiebinger (1999) notes that "the exclusion of women [from science] was not a forgone conclusion" (26) and that "several avenues into scientific work existed for women before the stringent formalization of science in the 19th century" (26). For example, women made contributions to the geosciences since the field's

inception. Many early women geologists were trained by and worked as assistants to a male relative, such as a husband or brother (Burek & Kohlbl-Ebert 2007). Although only a few Western women geologists were formally recognized for their work (for example, given credit in professional journals) in the 18th and 19th centuries, for example, Eltheldred Bennett (1776-1845) (Laming & Laming 2007), women still had the opportunity to make important contributions to and shape the field. Although anomalies, these women's family names and status within the community shielded them from questions of impropriety and enabled them to work in a "masculine field" (Burek & Kohlbl-Ebert 2007). In fact, women were so accepted that the Geologists' Association in London (1858) admitted them as full and equal members—although this organization was ahead of its time (Burek & Higgs 2007).

The professionalization and institutionalization of the sciences into universities that occurred during the 19th century worked to marginalize and exclude most women from its practice. According to Schiebinger (1999), during this period the practice of science was reorganized around a man whom had few responsibilities, and who could and would dedicate his life to the study of the field of his choice:

> Scientific institutions—universities, academia, and industries—were structures upon the assumption that scientists would be men with wives at home to care for the families. The smooth working of the professional world in many ways depended on the unacknowledged contributions of wives who fed, clothes, and cared for their professional husbands, providing well-run homes and ready support to further men's careers (Schiebinger 1999, 29).

In other words, science was reorganized around Acker's (1990) "disembodied worker."

Women who wanted to participate in the sciences in this era had two choices: 1) take the formalized route into the sciences (be educated in a university), an option that was unavailable to many women around the world (until the 20th century for many American women); or 2) contribute to the sciences, but do so in ways that were invisible, and that reified the practice of science as the domain of men (Schiebinger 1999, 29).

In *For Her Own Good,* Barbara Ehrenreich and Deidre English (2005) trace how women, once formidable practitioners of healing and of obstetrics, were excluded from the practice of medicine. In Britain, women who sought formal education in the

geosciences after its institutionalization had their "decency" called into question (Burek and Kohlbl-Ebert 2007). British high society bristled at the thought of women traveling to geological field sites with men to whom they were not related. While work-around solutions were developed to allow women to be in the classroom or field without offending cultural standards of decency (for example, wives of male professors escorted women students on fieldtrips), these solutions severely impacted the opportunities available to developing and established women geoscientists (Burek and Kohlbl-Ebert 2007). For example, women did not have access to the mentorship of their male professors and were unable to form collaborative relationships with their male peers.

Andrew Abbott (1998) has documented, on a more general level, how the process of professionalization works to exclude certain groups from practicing in a field. Through several rather predictable processes, members stake a claim in a field, for example, creating a formal education and credentialing process that limits who is able to claim "expert knowledge" or skills in an area (Foucault 1973). Although many women now have access to the practice of science (thanks to the work of liberal feminists), the fact that the credentialing institutions and science work organizations were created by (white) men and for (white) men, holds important consequences for women and minorities.

For example, (men's) science has a long history of being used to justify ill-treatment treatment of women, and especially, poor women. Scientific findings often mimic the cultural beliefs of those interpreting them (Kimmel 2011). For example, some sociobiologists have used science to justify and apologize for male rape of women (Kimmel 2011). Scientists in the Cold Spring Harbor Laboratory in New York drew on scientific work to justify the sterilization of poor American women in the early 20th century. Ehrenreich and English (2005) captured many of the negative ways women have characterized, and treated, by doctors and psychologists based on sexist ideas. Today, many feminists critique the way that hospitals handle pregnancy and birth, and argue that the processes used are to increase convenience for male doctors, rather than created with women's best interests at heart. As Barr and Birke (1999) conclude, "science is too powerful a kind of knowledge in late twentieth-century western culture to be left to the boys."

Some scholars have argued that increasing the number of women in science should not be the only end goal of feminism. Rather, feminists need to press for change to create a new form of science—a science that reflects a broader range of interests and needs than those of the stereotypical scientist, a white man in a white lab coat (Barr & Birke 1998; Schiebinger 1999). While it is easy to fall into the trap of "difference feminists," and to argue that women, by virtue of being women, are different than men (Schiebinger 1999), I will attempt to avoid this false dichotomy between the sexes, and instead suggest the some women, some minorities', and even some white men are excluded by science in its current form. The counter is that some women and minority men do not experience a disconnect between science as currently practiced and their own interests, values, ideas, and goals as practitioners of science. Women, after all, can be "old boys," too (Schiebinger 1999).

Barr and Birke's (1998) study of women adult learners in United Kingdom revealed many ways in which women have been excluded from the sciences. According to Barr and Birke (1998), three processes took place to alienate women in marginalized groups from the sciences. First, as I have discussed, science became professionalized, and as part of this process, scientists became beholden to the scientific community, rather than community at large, for their work. Second, science education became "abstracted" and disconnected "from the social values of the wider society" (Barr & Birke 1998, 27). Third, science was taught in a school, and this formalized way of teaching and learning science was given more weight than science learned through personal observation and experience (Barr & Birke 1998, 27). According to Barr and Birke, marginalized populations incorporate science into their everyday lives, such as when the poor recognize that drinking from certain wells cause sickness, or how to tell certain diseases from sustained observation. However, they do not recognize this as science and see science as something difficult, and only other people can do (Barr & Birke 1998, 64-65). Bar & Birke (19998) found that marginalized women saw science as irrelevant to their lives, given its abstracted form.

This claim, that science does not meet "women's needs" is relatively common among feminists (Schiebinger 1999). There is reason to suggest that women may have special contributions to make to how science is practiced (only however, if institutions

become more open to change, which the current socialization process of scientists discourages). However, we must be careful in placing women's experiences and viewpoints of science on the opposite side of the spectrum than men's. According to Schiebinger (1999), assuming women's "empathy" or other feminine traits are responsible for good science ignores women's hard work and intellect.

In investigating women's experiences in science, it is important to consider the way the practice of science, and the goal of the scientific endeavor, has been shaped by masculine norms. For some women, this may add to the difficulties already surrounding working in a highly gendered institution and being held to masculine standards of performance. However, women who make it to graduate school likely feel less of a disconnect from science than other women, who probably filtered out of the sciences earlier, for example, in middle or high school.

I have drawn on three veins of theory, Joan Acker's theory of gendered organizations, theories regarding socialization into graduate school, and theories regarding the marginalization of women within the practice of sciences in order to suggest ways that women may accumulate (sometimes invisible) disadvantage in graduate school. I argue that women's graduate school experiences may place them at a disadvantage later in their career, if not directly during graduate school (Etzkowitz, Kemelgor, & Uzzi 2000). In addition, women's experiences in graduate school, whether perceived as positive or negative, will shape their orientation toward various career options, and their future career plans.

This is the theoretical standpoint from which I undertake the following study of graduate students' experiences in elite geoscience programs. I define "elite programs" as top-ranked geoscience programs and/or geoscience programs at so-called "oily schools," which receive funding and support from the oil & gas industry and are recognized for their production of high numbers of geologists (and/or engineers) who attain employment in the industry. Recognizing that the data comes from students in these programs is important, because expectations that they learn the "hidden curriculum" of graduate school (Rios 2010) or develop into geoscientists that fit the job description of an industry worker, with its unstated assumptions of what such a worker should look like, are likely

higher than at mid-tier or lower-tier schools. In studying the extreme case, however, it may be easier to locate gender bias.

Although this is a study primarily focused on how graduate students' experiences in the geosciences are framed by gender, I do not consider gender to be a variable from which other characteristics can be separated. Gender is only part of what shapes an individual's experiences and attitudes, as well as race, age, nationality, and a number of other characteristics, such as family background and current family formation. Drawing on the influence of Patricia Hill Collins (2000), I take an intersectional approach to my analyses. The fact that my sample is majority white and American has important consequences for the experiences they share about their time in graduate school

This paper is a feminist undertaking. However, it is a specific feminist undertaking. I do not see men and women as essentially different, recognizing that there is more internal differentiation within men and within women than between these groups In addition, there are multiple ways to be "a man" or to be "a woman," such that the experiences of women differ drastically, as do the experiences of men. Nor do I see gender as the only, or most important, characteristic in shaping the experiences of individuals. To do so is often to implicitly assume a white, middle class version of experiences as representing all women's experiences (Collins 2000). However, as members of a subordinated group, women are subject to many of the same types of bias and discrimination that work to maintain gender inequality. These forms of discrimination and bias cut through the differences that help to shape women as individuals, although groups of women may experience male dominance differently from one another (Collins 2000). In writing from a feminist perspective, my goal is to bring the ways in which gender inequality is maintained in the geosciences (and sciences more generally) to light, as social change is only possible once inequality has been recognized and is understood. Below, I discuss my methods for engaging in this research and provide a layout of the rest of this thesis.

Methods

In order to investigate how gender operates in graduate school to potentially disadvantage women, I conducted in-depth interviews with 13 graduate students in the geosciences from four geoscience departments. Interviews were uniquely suited to provide insight into students' experiences in the geosciences, as well as how students' perceived these experiences as affecting their personal life and future career. The interviews were semi-structured, which provided an opportunity to explore interesting themes that emerged but that were not included in the interview guide. However, all interviews explored the following general topics areas: students' entry into the geosciences as a field; previous work experience; motivation for attending graduate school in the geosciences; choice of graduate school; experiences in graduate school, exposure to careers; and future career plans. Interviews lasted from 40 minutes to two hours, with most lasting about an hour.

Respondents were self-selected and were recruited through letters sent to graduate advisors and/or professional contacts at six geoscience departments. Multiple students from each of four departments responded. By interviewing several students in each department, I gained was able to gain valuable insight into the departmental context that shaped students' experiences (Fox 2001; see also Rosser 1999).

Although I focus mainly on women's experiences in the geosciences in this study, by including men I was able to gain a broader perspective of the different processes that work to shape graduate students' experiences in the geosciences. Although members of a privileged class are often less likely to recognize discrimination and bias (see Kimmel 2011, pages 5-9 for discussion), some men were cognizant that women in the geosciences may face unique challenges, while one man provided me "virtual" access into an all-male space by sharing conversations he had held with his officemates regarding women colleagues. In analyzing my data, I paid close attention to how gender shaped the interview experiences. In particular, I paid special attention to: 1) how research participants framed their responses to avoid "offending or threatening [me] with unflattering or socially undesirable opinions"; and 2) when respondents made assumptions regarding our shared experiences (Williams & Heikes 1993). While gender,

(along with race and other characteristics) undoubtedly helped to shape the interviews, our shared status as graduate students helped me gain rapport with my respondents and was frequently referenced by participants in assessing how well I understood them.

Eight of the respondents were enrolled in a doctoral program; five were enrolled in a terminal master's program. Most research participants were in their late twenties, with several in their early twenties or mid-thirties. Two were married (both to fellow geoscientists), and three were engaged. None reported children. More detail on the sample and the four departments from which they come can be found in Appendices A, B, and C.

All interviews were recorded with the permission of the research participant and transcribed. I then read over the transcripts to identify reoccurring themes, using inductive coding as described by Charmaz (2006).

In addition to conducting interviews, I conducted several ethnographic field site visits to student recruitment events aimed at geoscientists (one held by an oil & gas company and aimed at non-geoscientists, as well as a 2-day recruitment event specifically for geoscientists). Students in the geosciences may be heavily recruited by oil & gas companies, especially if they attend what are known as "oily" schools. I was interested in the messages students received in these recruitment sessions about what a career in the oil & gas industry looks like, particularly how the oil & gas industry overcame its stereotype as an "old boys' club" to attract women. Conferences on the energy/oil & gas industry and workforce addressed problems in recruiting and retaining geoscientists, and provided a broader perspective of how the industry works. Field notes, conference notes, as well as general observations and insights garnered through attending these events are drawn upon in this paper.

Overall, the students in my study were engaged with and enjoyed their field of study, and they were generally grateful for the opportunities that graduate school provided them to continue formal learning in the geosciences and to engage in research on topics that interested them. Women were varied in regards to their perceptions of how their gender impacted their experiences in the geosciences. Women with professional work experience in geoscience workplaces or industries appeared to have developed an extensive critique of the types of bias women might experience in the sciences.

Regardless of their perceptions of how gender shapes the graduate school experience, the interviews suggest that being a woman or man does affect one's overall experience as a scientist in important ways. To the extent that the women graduate students in this study reported experiencing more overt types of gender-bias, like visible discrimination or sexual harassment, in graduate school, they had many resources to draw on to help mitigate what can be painful and difficult experiences. However, this does not mean that these experiences did not add to their "cumulative disadvantage" and that these nicks in their armor won't affect them later on in their careers as scientists (Etzkowitz, Kemelgor, & Uzzi 2000). While some women expressed awareness of the continued challenges that awaited them upon entering the workforce, they varied in their planned response to them. A critique of how women (and especially mothers) are systematically discriminated against in the science workforce, as well as work organizations more generally, stood in contrast to a belief that the major challenge faced by women in the geosciences are "old dirty geologists" soon to be replaced by "young, vibrant, good scientists," expressed in several interviews and reinforced by oil & gas industry recruiters. [1]

Organization of the thesis

Chapter 2 provides a brief overview of research on women in science. In Chapter 3, I explore students' stories about their pathway into the geosciences, with a focus on how they developed an interest in the geosciences, their motivation to attend graduate school, and the act of selecting a graduate program. In Chapter 4, I examine how gender shapes my respondents' experiences in graduate school, including relationships with other graduate students and advisors. In Chapter 5, I examine students' perceptions of the job opportunities available to geoscientists, with a focus on students' perceptions of the oil & gas industry and academia. Finally, I summarize the findings to this study and explore the theoretical implications of my research.

[1] Quote from Evan, a male graduate student, sharing discussions he held with his wife, a post-doc, about the gender issues women face in the geosciences.

Chapter 2: Literature review

The purpose of a literature review is to provide readers with the background information that helped to drive, and aids in contextualizing, the investigation in process. In this chapter, I review extant research conducted on the challenges faced by girls and women in the fields of science, technology, engineering, and mathematics (STEM).[2] Government departments have produced reports on the status of women in STEM throughout the twentieth century (Women's Bureau 1948, Rossi 1965). However, since the 1970s, the call to action to increase the size and the diversity of the science and engineering (S&E) workforce has grown in volume (Schiebinger 1999). Accordingly, the U.S. government and industry have spent billions of dollars over the past few decades in an effort to determine why more Americans do not pursue S&E education, training, and careers, and why members of some groups are less likely than others to be working as professionals in these fields. Partially in response to these funding opportunities, hundreds of reports, articles and books have been written on 1) recruitment into and experiences in S&E educational programs; 2) the experiences of scientists and engineers once in the S&E workforce; 3) racial and gender disparities in S&E educational programs and the workforce; 4) explanations for these disparities; 5) programs designed to increase interest in the S&E fields, especially among underrepresented groups; and, finally, 6) methods to retain current scientists and engineers. A great deal of this literature is focused on women, who are grossly underrepresented in educational programs in several fields and whom are at greater risk of dropping out of the S&E workforce than men (National Science Foundation (NSF) 2007, National Research Council (NRC) 1994). Much of this research is helpful in thinking about women's experiences in the geosciences, which remains a male-dominated and masculine-identified field, despite the fact that its graduate schools have achieved near gender parity in enrollment.

At the end of this chapter, I provide context on the structure of geoscience education and the geoscience workforce. This information is necessary for

[2] Some studies and reports refer only to the fields of science and engineering, abbreviated as S&E.

contextualizing men and women graduate students' interactions with the field and for an understanding of the job market they face upon exiting graduate school.

The woman deficit model and the response of feminist researchers

In her 1993 book Eileen Byrne argued that many of the extant theories used to explain why men continue to dominate the S&E fields, either in educational institutions or the workforce, place implicit blame on women, as do the "solutions" for fixing the lack of women in the sciences. For example, some researchers have argued that women have different cognitive abilities than men, and as such, are not as qualified to enter the S&E fields (an assertion that has been largely discounted by Janet Hyde's research; see Hyde 2006).

Feminists, who share the goal of rooting out gendered inequality, have conducted some of the most thoughtful research on women in the sciences. According to Schiebinger (2009), there are three feminist approaches to the study of women in sciences: the liberal feminist approach, the difference feminist approach, and a third feminist approach, surrounding the use of scientific methods.

Liberal feminists argue that women are equal to men, and as such should be given equal opportunities to participate in the sciences. Liberal feminists have been responsible for removing many of the overt barriers to women's participation in the sciences, for example, by fighting to open the doors of colleges and universities to women, and by rallying against protective legislation and policies that prevented women from working in certain fields and jobs. According to Schiebinger (1999), the problem with liberal feminism is that it does not challenge the ways in which the sciences and science workplaces are gendered masculine: "Women are supposed to assimilate to science rather than vice versa; it is assumed that nothing in either the culture or the content of the sciences needs to change to accommodate them" (4). "Difference feminists" argue that women are different than men (either due to biology, socialization, or a combination of both), and as such, women have special contributions to make to science (Morse, 1995; Schiebinger 1999, 5). Some feminists, for example, argue that women do science with more of an eye to its benefit for community, and less in pursuit of

abstract goals or knowledge for knowledge's sake. Thus, women pursue a more "ethical" science. While difference feminists question the supposed gender neutrality of science, they also reify beliefs about the essential nature of and differences between men and women (Schiebinger 1999, 5). According to Schiebinger (1999), a third group of feminists works to develop new methods of doing science to better serve feminist ends. For example, feminist historians developed new methods for researching women's lives, broadening the spectrum of sources they relied on because women were often excluded from the traditional archival sources used to study men (Schiebinger 1999, 7). One critique of this group is their tendency to wholly abandon existing modes of research, such as quantitative methods, on principle, instead of using them in ways appropriate to advancing feminist goals (Schiebinger 1999).

Although they come from varying perspectives, feminist researchers studying women in the sciences pursue a shared end. Rather than pursue a women deficit model of research (Byrne 1993), feminist researchers ask what about the sciences, and the contexts in which the sciences are embedded, work to exclude or marginalize women, as school children, college students, and/or as experienced science professionals. They recognize that women's exit from science and engineering is not evidence of women's faults or failures, or even personal choice, but rather the result of unequal treatment, experiences, and opportunities in these fields (NRC 1994; Etzkowitz, Kemelgor & Uzzi 2000), and/or a definition of science and mode of participating in science that may exclude some women (Schiebinger 1999, Morse 1994, Harding 1991). As this is a feminist undertaking, I rely on research with this outlook, rather than research that posits a woman deficit.

Research on girls' and women's science education experience

In this section, I investigate research on women's experiences with the sciences in their K-12, undergraduate and graduate educations. Many books and articles refer to the standard educational trajectory (e.g., student takes appropriate number of math and science courses in high school, enrolls in a technical school or college with a science or engineering major, and potentially, continues on for an advanced degree in the field,

before graduating and joining the S&E workforce) that future scientists are expected to follow as the "pipeline."

Those who adhere to the S&E pipeline framework argue that if one wants to increase the number of women (or minorities or workers, in general) in the S&E workforce, the pool of potential scientists and engineers must be increased, for example, by using innovative teaching methods designed to get girls more interested in the sciences, or by providing girls with opportunities to meet women scientists and learn about their work.

Others have pointed out, however, that while these methods might work to attract more students to take S&E courses or even to decide to pursue a S&E major, they will not put an end to the differential rates in men and women's exits from S&E educational programs and the S&E workforce (see for example, NRC 2004). This is because the "pipeline" does not function the same way for all potential scientists. As the National Research Council (1994), summarized:

> The problem with the pipeline metaphor is that it is passive. Presumably, women enter the pipeline during the educational process, and, if they persevere, will have opportunities to advance, like any male employee. The pipeline metaphor, however, does not take account of the possibility that the pipeline itself and the "pond" into which it empties may not be neutral (31-32).

Noting this is true, some researchers now refer to the S&E pipeline as the "leaky" pipeline.

However, even the concept of the "leaky" pipeline fails to account for an important fact about science careers. Leaving the sciences does not preclude someone from returning to the field. Using synthetic life course analysis to study science careers, Xie and Shauman (2005), found that rather than being linear and predictable, science careers, and especially women's science careers, tend to be "fluid and dynamic":

> Exit, entry, and reentry are real possibilities. Many persons, especially women, become scientists through complicated processes rather than just by staying in the pipeline (Xie 2006).

According to Xie and Shauman (2005), as well as others (see, for example Beoku-Betts 2004), the pipeline metaphor does not accurately describe women's experiences of being educated and trained in the sciences. For these two reasons, I avoid using the pipeline

concept, despite its continued usage in studies of women in science. (Although, my review of the literature suggests the pipeline metaphor may be losing some currency, largely for the reasons provided above).

Girls and science (TEM) in K-12

Evidence suggests that boys and girls begin school with roughly the same levels of interest in science as young children. However, by the time they reach their senior year of high school boys are more likely to express interest in science than girls (56 percent vs. 48 percent) (Bae, Choy, et al. 2000). Van Leuven (2004) found that between seventh and twelfth grade, girls' degree-level goals decrease, as does their interest in pursuing science (and/or math-based) careers. This research, along with other studies of a similar vein, suggests that certain processes happen in adolescence that turn girls, more so than boys, off from science.

Multiple theories have been proposed to suggest why girls lose interest in science between elementary and high school. Some researchers argue that girls do not have access to enough women role models in science: that there are not enough examples of women in books, television, or other forms of media, nor do girls get the chance to meet real women scientists. They argue that without easy access to role models of women scientists, few girls are able to envision themselves in this role; instead girls come to believe that only men are scientists and that science is not a viable option for them (Barr & Birke 1998). Indeed, most people do equate the practice of science with men. Finson (2002) reviewed 50 years of research on "draw-a- scientist" studies, which are studies designed to capture cultural stereotypes that people hold about what a scientist is and the work that scientists do. She found that when people are asked to draw a scientist, most draw a Caucasian male: This is true of men and women, people of different races, ethnicities, nationalities, and ages, and is a finding that has held remarkably stable through time (Finson 2002). Still, other studies suggest that girls receive explicit and/or implicit messages from teachers, family members, and/or peers that discourage them from pursuing an interest in S&E fields (Brotman & Moore 2008; Jacobs & Bleeker 2004; Stake & Nikens 2005). Peers can be especially influential to girls' pursuit of a field, as several researchers found of mathematics (Frank, Muller, Schiller, et al. 2008).

While some authors suggest that women are excluded from the sciences because of their lower math scores, Xie & Shauman (2005) argue that the critical filter hypothesis is incorrect: Differences in math achievement do not determine the varying rates of men and women's entrance into S&E fields. Rather, it seems more likely that girls are responding to social cues that science is inappropriate for them, or responding to a disconnect between the practice of science and their own goals and values, as discussed in the introduction.

Jacque Eccles (1994) has provided one of the most comprehensive models to explain women's educational and career choices, suggesting that women draw on many sources of information (which all interact and/or counteract), including cultural stereotypes, messages from key socializing agents (e.g., parents, peers and teachers), past experiences (and perceptions of those experiences), affective memories, perception of self, personal goals, assessments of their aptitude, and expectation of success, to determine what sorts of tasks are appropriate for them and, thus, which fields to explore. Thus, if young women receive messages from the important people in their lives that they are better suited for other fields than the sciences, and these messages are supported by the culture in which they live (e.g., no women scientists on TV), and reaffirmed by their own experience of the field (perhaps poor, because of lack of encouragement) or perceptions of those experiences, they will be unlikely to pursue a career in the sciences.

Women's experiences in higher education in the sciences

The transition between high school and college is when the greatest number of potential female scientists is "lost" (Xie & Shauman 2005). Only 26.3 percent of freshmen women express an interest in majoring in an S&E field, compared to 40.8 percent of freshmen men (NSF 2007). While women are more likely to express an interest in pursuing a degree in social/behavioral sciences and the biological/agricultural sciences than men, they are less likely than males to express an interest in pursuing a major in mathematics/statistics and physical sciences and *far* less likely to express an interest in pursuing a major in computer sciences or engineering (NSF 2007).

On the whole, women actually earn a greater percentage of the bachelor's degrees awarded in S&E fields than men, and have since the turn of the millennium (NSF 2007).

However, a closer look reveals that disparities still exist. Women are far less likely than men to earn degrees in S&E fields perceived to be more math or theory-oriented, including computer science, earth, atmospheric, and ocean sciences, mathematics and statistics, the physical sciences, and engineering (NSF 2007).

In 2004, women earned 44 percent of all S&E masters degrees and only 37.4 percent of all S&E doctoral degrees (NSF 2007). The same pattern of degree-earning seen at the bachelor's level persists at the master's level, with women being less likely to earn a master's degree in computer science, earth, atmospheric, and ocean sciences, mathematics and statistics, the physical sciences, and engineering than men (NSF 2007). Women have not caught up to men at the doctoral level, where they receive the majority of PhDs granted annually in only one S&E field: psychology (NSF 2007).

As I argued in the introductory chapter, extant research on women in graduate school in the sciences suggests they face additional challenges during graduate school than their male colleagues. For example, women may face isolation or stigmatization as "female tokens" in a male-dominated graduate program (Kanter 1972; Etzkowitz, Kemelgor, & Uzzi, 2010). Even in a graduate program with many women, women may be isolated in all-male labs (Etzkowitz, Kemelgor, & Uzzi, 2010; see also Rosser 1994).

Some studies have found that women may face overt or subversive forms bias and discrimination from faculty members and/or other graduate students—which need not be only men (Beoku-Betts 2004; Etzkowitz, Kemelgor, & Uzzi, 2000; Etzkowitz, Kemelgor, Neuschatz, & Uzzi, 1994; Schwartz et al. 2003). Though not focused on science graduate education only, Myers and Duggan (1996) found significant gender bias in graduate school classrooms. Due to gender bias and homosocial reproduction, several studies have found that women graduate students may lack access to student and faculty networks that foster scientific creativity and collaboration, which Etzkowitz and colleagues (2000) refer to as the "'kula ring' of scientific success."

As mentioned earlier, women might also have difficulties adapting to the norms of academia (Rios 2000; Etzkowitz, Kemelgor, & Uzzi, 2000). For example, Etzkowitz and colleagues (2000) suggest that women might not be socialized to take the risks associated with making scientific gains (85). Women who adapt to the norms of academia may be penalized for thwarting gender norms (J.C. Williams 2006).

Having children during graduate school in the sciences, as mentioned earlier, has been problematic to women's success and potentially, continuation, in their programs (Etzkowitz, Kemelgor, & Uzzi, 2000; Etzkowitz, Kemelgor, Neuschatz, & Uzzi, 1994; Mason 2006). Women whom have "early" babies have a high likelihood of exiting academia before obtaining their first tenure track job and "having no babies at all in the dominant success mode for women" in academia, according to Mary Mason (2006).

Patricia Hill Collins (2000) has theorized that the disadvantages of being a woman and a minority are not additive; rather, they intersect to form new types of oppression. Indeed, extant research suggests that women of color face barriers unique from white women as graduate students in the sciences. MacLachlan (2006) conducted qualitative interviews of women in STEM doctoral programs the UC system, the majority of who were racial and ethnic minorities. Many of these students reported experiencing sexism and/or racism from colleagues and/or advisors. Beoku-Betts (2004) found that African women from third world countries who attended graduate school in the U.S. struggled to combat stereotypes not only about women, or women of color, but also about their home country. Some women were put in the role of becoming a "representative" of their country, while others were reclassified by their peers as black, rather than African, and suffered a loss of identity (Beoku-Betts 2004). Many of the women in Beoku-Betts' study perceived that their peers and graduate school faculty did not think that they belonged in the program, a feeling shared by the African American graduate students in Schwartz and colleagues' study (Schwartz et al. 2003). Students in Beoku-Betts' study were also disadvantaged in graduate school by their family obligations: Many had children and very traditional husbands who were resistant to help with what they felt were women's tasks. Schwartz and colleagues (2003) found the opposite: Many of the African American women in his study talked about the support they had received to seek higher education from their families. They attributed this support to the fact that they were black *and* they were women, and noted that black men were not pushed to succeed in the same way. These students reported feeling isolated from their white peers and felt their race, more so than their gender, framed their experiences of graduate school (Schwartz et al., 2003).

Women's experiences in the science workforce

Women are underrepresented in the S&E workforce. In 2007, women made up only 27 percent of the S&E workforce, despite holding 40 percent of all S&E degrees (NSB 2010). Women are especially underrepresented in S&E industry (NRC 1994). Women may be excluded from industries because of the use of networks to hire new employees or because they don't fit unspoken criteria for applicants (NRC 1994, 1, 19).

Although the research is somewhat dated, the National Research Council (1994) found that women have twice the exit rate from S&E industry than men (29). Exit rates between men and women were most disparate in the first 10 years of employment (NRC 1994, 30). There are a number of reasons that might cause women to leave industry at a higher rate than men. According to the National Research Council (1994): "Once on the job, many women find paternalism, sexual harassment, allegations of reverse discrimination, different standards for judging the work of men and women, lower salary relative to their male peers, inequitable job assignments, and other aspects of a male-oriented culture that are hostile to women (NRC 1994, 1). J.C. Williams (2006) gathered together a list of attributes of the "chilly climate" faced by many women scientists in their work environments. She argued that although these often do not "look" like we expect gender discrimination to, they have the same effect of excluding women from fair and equal participation in the sciences.

Lack of confidence can affect women's success, given the emphasis in workplaces on self-promotion. Women tend to underestimate, while men overestimate, their abilities and probability of success to reaching their goals (Schiebinger 1999, 58). Lack of confidence prevents many women from striving to attain higher positions, not only in the workplace but also in politics (Fox & Lawless 2004), and even the world of volunteer soccer coaches (Messner 2009). As a result women tend to be more qualified for the positions that they hold than men (Schiebinger 1999, 60). But lest we blame women for not reaching higher ranks within industry because of a personal deficit, it is important to understand the social processes that result in women's, on average, lower confidence in their abilities, a system that is built on gender inequality. Women in the sciences, for example, report being cut off by men, or having their assertions undercut by

men. Some women feel that they have to work much harder than men to receive the same level of respect (Rosser 2004, 25). Although most students that end up in graduate education in the sciences and in the science workforce have had relatively positive experiences in science (the ones who didn't typically have already dropped out), Etzkowitz and colleagues (2000) argue that over time the negative experiences add up, resulting in a cumulative disadvantage that may impact women's career progression and confidence in herself as a scientist.

Women scientists are underrepresented in academia, in addition to industry, especially in tenure-track positions and at the highest levels of professorship (Holmes, O'Connell, Frey, & Ongley 2008; NRC 2010). Many of the processes listed above affect women in academia just as they do women in industry. However, the rigid structure of academia, as well as different expectations and standards of what an academic scientist is versus an industry scientist, provide unique challenges to women in academia.

There is some evidence to suggest that conditions for women faculty members in the sciences, which historically have been poor, are improving. In a study of women at critical transition points, the National Research Council (2010) found that women who applied to academic positions in SEM had a good chance of being interviewed and receiving the first job offer. They found women and men had similar access to most institutional resources, although evidence suggested than men may have more access to science equipment. Men and women were similar on many indicators, such as awards and honors, salary, and offers from outside institutions. Women up for tenure were actually more likely to receive it than men who were also up for tenure, and men and women up for full professorships were equally likely to be promoted. This caused the NRC (2010) to summarize: "For the most part, men and women faculty in science, engineering, and mathematics have enjoyed comparable opportunities within the university, and gender does not appear to have been a factor in a number of important career transitions and outcomes" (4). However, this statement does not account for the fact that women are underrepresented in the pools of applicants to university positions and to tenure, a disparity that the NRC (2010) notes, but does not attempt to explain. As Mason (2006) demonstrates, more women filter out of academia at critical transition points in the academic career than men.

We can look to other research to gain greater understanding of the reasons women might leave academia at a higher rate than men. Women's token status on most science faculties can cause added career challenges. Because there are very few of them, women may be called to be on more committees and to advise more students (NSF 1997; Rosser 2004, 42) making it more difficult for them to remain productive in ways that count towards tenure (Rosser 2004, 42). Another problem facing women academics, especially (as they are more likely to be married to other scientists, Rosser 2004), is the dual-career problem. Couples seeking joint appointments within the same department, university, or at neighboring universities typically struggle (Rosser 2004, xxi). Often, men's careers are put before women's in these situations (Schiebinger 2008).

Rosser (2004) argues that women seeking tenure face difficulties in combining work and family: "Although family responsibilities become difficult to balance with work for some men who take on significant child care responsibilities, balancing the tenure clock with the biological clock challenges women scientists and engineers who want to become biological mothers in ways never faced by men because they cannot become pregnant" (Rosser 2004, 42). J.C. Williams (2006) calls the additional barriers mothers face (and men who mother) in the sciences the "maternal wall." Women geoscientists in academia listed the following issues/challenges/opportunities as the most important to women as they plan their career, with their number one being balancing work with family responsibilities (74 percent), followed by: low numbers of women, isolation, and lack of camaraderie/mentoring (40 percent); affirmative action backlash/discrimination (23 percent); balancing career with spouse's (21 percent); time management (21 percent); active recruitment of women/ more opportunities (16 percent); funding (11 percent); and job restrictions (11 percent) (Rosser 2004, 64).

Pattatucci (1998) calls the additional barriers to women's success in academia simply the "extra stuff," acknowledging that this "extra stuff faced by women is pervasive and exists in the system at all levels" (Pattatucci 1998, 9). According to Pattatucci (1998), women will not fare as well as men in the sciences as long as they must face this extra stuff:

> Until the extra stuff in women in science confront is acknowledged and addressed by the scientific community, accompanied by the establishment (or revamping of institutional policies concerning recruitment and

> retention, slowing the tenure clock, crediting mentoring functions in tenure reviews, child care, and parental leave, women will continue to be underrepresented in scientific disciplines (13).

Although there is much more research on women in the sciences, my review of the literature, presented above, provides a strong contextualization for this study, and is representative of the major themes in research on women in the sciences.

Overview of the Geosciences

In this section, I provide an overview of the current educational and workforce trends in the geosciences. Throughout this section, I rely heavily on research produced by the American Geological Institution (AGI), an umbrella organization working to provide information, educational programs, and other supports to 49 member geoscience organizations. AGI collects its own data, in addition to utilizing data from national sources, to produce frequent reports on trends in geoscience education, training, and workforce composition. It is by far the best resource for consulting on these issues. The purpose for this section is to contextualize my study of graduate students in the geosciences within the discipline as a whole.

What are the geosciences? Who counts as a geoscientist?

What is a geoscience, and who counts as a geoscientist? Defining both is a necessary task but also a relatively complicated one. The operational definitions of "geoscience" and "geoscientist" vary across organizations collecting the data used to track the trends affecting them (Gonzales, Keane, & Martinez 2009, A). In reporting any data, then, the American Geological Institute relies on the collecting organization's classification systems, of which there are no fewer than five (Gonzales, Keane, & Martinez 2009, A).

In an attempt to promote a more standardized use of the term "geoscience," AGI has written and widely promoted a working definition. AGI classifies those who engage in the following work activities as geoscientists:

> Studies the composition, structure, and other physical aspects of the earth. Includes the study of the chemical, physical and mineralogical

> composition of soils, analysis of atmosphere phenomenon, and study of the distribution, circulation, and physical and chemical properties of underground and surface waters. May study the earth's internal composition, atmospheres, oceans, and its magnetic, electrical, thermal, and gravitational forces. May utilize knowledge of various scientific disciplines to collect, synthesize, study, report, and take action based on data derived from measurements or observations of air, soil, water, and other resources. May use geological, environmental, physics and mathematics knowledge in exploration for oil, gas, minerals, or underground water; or in waste disposal, elimination of pollutants/hazards that effect the environment, land reclamation, or management of natural resources (Gonzales, Keane, & Martinez 2009, A.15).

According to AGI's working definition, environmental scientists, hydrologists, oceanographers, atmospheric scientists, geologists, geophysicists, climate scientists, geochemists, and paleontologists all fall under the heading of geoscientist (Gonzales, Keane, & Martinez 2009, A.15). Geoengineers (environmental, exploration, and geotechnical) and geomanagers are considered geoscience-related occupations (Gonzales, Keane, & Martinez 2009, A.15). Unless otherwise indicated, when I use the term geoscience I am evoking the American Geological Institute's definition. However, like AGI, when reporting data, I am reliant on the collecting organization's definition. I try to be as transparent as possible in reporting any statistics.

Trends regarding the geoscience education pathway

K-12

A typical student is first exposed to the formal study of earth science in elementary school, in which earth science related topics are inter-dispersed throughout general science courses (Gonzales & Keane 2011, 2-3). More intensive study of earth science occurs in middle school; it varies by district or state, however, whether earth science is integrated into general middle school science courses or offered as a separate year-long course (Gonzales & Keane 2011, 2-3). All 50 states and DC include some form of earth science learning requirements for students in grades six through eight (Gonzales & Keane 2011, 3).

For most students, formal exposure to earth science ends in middle school. In fact, over three-fourths of students graduate without having taken a high school-level earth

science course, a trend that has remained consistent across decades (Gonzales & Keane 2011, 1). By comparison, almost all graduates (around 90 percent) have taken a high-school biology course, about 70 percent have taken a high school chemistry course, and about 30 percent have taken a high school physics course (Gonzales, Keane, & Martinez 2009, 1). Out of SAT-takers (one indicator of plans to attend college), almost all have taken biology in high school, about 90 percent have taken chemistry, and only about half have taken a physics or geology course (Gonzales & Keane 2011, 18).

The above figures are unsurprising when we consider how few states require earth science for high school graduation (4 states) or count earth science towards the science credits required for graduation (12 states) (Gonzales & Keane 2011, 7). In addition, the number of teachers with a specialty in the geosciences lags far behind the number of teachers with specialties in other sciences at this level (Gonzales & Keane 2011, 13). High school exposure to the geosciences is unevenly distributed across the United States: For example, Utah and NY have the highest percentage of ninth grade students enrolled in earth science (about 95 percent and 75 percent, respectively), with only 9 more states enrolling more than 30 percent of their ninth graders in an earth science course (Gonzales & Keane 2011, 11).[3] There is no difference in the percentage of men and women taking a geoscience course at the high school level on a national-level (Gonzales & Keane 2011, 12).

Although the SAT does not collect information on the geosciences in particular, data collected by the SAT suggests that less than 2 percent of test-takers (mainly high school juniors and sophomores) plan to pursue a degree in the physical sciences at the college level: In 2009, this percentage accounted for only about 16,000 SAT test-takers (Gonzales, Keane, & Martinez 2009, 1). Presumably, far fewer students plan to pursue a degree in the geosciences. The fact that students lack exposure to the geosciences at the high school level is important in explaining why so few students choose to major in the geosciences in college:

> The most significant choke point in the geoscience career pipeline is at its source: secondary schools. Unfortunately, most U.S. high schools do not provide courses that expose students to the geosciences. This problem is

[3] Ninth grade is the most common year for students who take earth science in high school to do so (Gonzales & Keane 2011).

> exacerbated by the lack of Advanced Placement courses in the geosciences. A lack of student awareness creates a substantial impediment to creating viable geoscience majors in college or for choosing the geosciences as a career (Ebert 2009).

Unless students take a geoscience course to fulfill a science requirement at the college-level, they are unlikely to receive exposure to this subject throughout their upper-level educations.

Upper-level education in the geosciences

About one in five community colleges have a geoscience program (Gonzales & Keane 2011, 27). The majority of community college geoscience departments are small, with about 60 percent of departments employing three faculty members or fewer (Gonzales & Keane 2011, 34). Roughly 200 degrees are granted each year from a core geoscience program, with about 2000 granted from geoscience-related programs (Gonzales, Keane, & Martinez 2009, 20). Nevertheless, the associate's degree remains an important gateway into the geoscience educational pathway: According to the American Geological Institute, "For most geoscience sub-disciplines over one-third of bachelor's and master's graduates and over 10 percent of geoscience doctorates attended community college during their academic career" (Gonzales & Keane 2011, 38).

Since the early 1990s, the number of geoscience majors has remained around twenty thousand, with peaks and dips of several thousand (Gonzales, Keane, & Martinez 2009, 2.26). This stable period was preceded by a precipitous decline in declared geoscience majors that took place in the late 80s (Gonzales, Keane, & Martinez 2009, 2.26). This decrease corresponded with the oil collapse of 1986, in which crude oil prices fell by more than 60 percent (Brown 2006). During the late 80s, many geoscientists working in the oil & gas industry became un- or under- employed (Brown 2006). In Texas alone, 175,000 jobs related to oil and gas extraction and oilfield equipment disappeared within a year (Brown 2006). These discouraging job prospects discouraged a new crop of young people from entering the geosciences (Gonzales & Keane 2010). It also caused a constriction in the size of geoscience departments, which has had a lasting effect on the number of geoscience students that can be trained in any given year (Brown

2006). Thus, the 1986 oil crisis is one cause of the shortage in geoscientists being experienced today.

Geoscience enrollments are not equal across the United States. California enrolls the most undergraduate geoscience majors and has the most geoscience departments (51), followed by New York (46), Pennsylvania (43), and Texas (39) (Gonzales, Keane, & Martinez 2009, 2.3-2.4). In 2006, about a quarter of all undergraduate geoscience majors were being educated in these four states (Gonzales, Keane, & Martinez 2009). The distribution of departments across the United States has been used to explain why Hispanics are better represented than African Americans within the geosciences (Gonzales, Keane, & Martinez 2009).

Enrollment in undergraduate geoscience programs is low when compared to enrollments in other sciences (NSF 2007). Stereotypic thinking may discourage even those whom have received upper-level exposure to geosciences from pursuing it as a college major. A survey of undergraduates enrolled in introductory geology classes at Northern Arizona University found that geology and environmental sciences were perceived to be easier and less prestigious degrees than degrees in biology, chemistry, and physics, as well as the lowest paying (Hoisch 2010, 36). Indeed, common slang for an introductory geoscience course is “Rocks for Jocks.”

The completion rate for geoscience majors is also extremely low, when compared to completion rates for majors in other science and engineering fields (13 percent vs. 59 percent) (Gonzales, Keane, & Martinez 2009, 2.1). Currently, the reasons for such a low conversion rate are unclear. In the past, degree earning in the geosciences was closely related to the price of oil, but recent data suggests these variables have been partially decoupled (Gonzales, Keane, & Martinez 2009).

Geoscientists who do not have a master’s degree have limited opportunities to find work in the field. The University of Pittsburgh’s Department of Geology and Planetary Science explains to its students “that you can view a bachelor's degree in geology or environmental geology in two ways”:

1. Preprofessional training that leads directly to a career, usually via graduate school, in the general field of Earth sciences; and

2. A broad, well-rounded undergraduate science program that offers excellent intellectual preparation for any of a large number of career options. (http://www.geology.pitt.edu/undergraduate/careers.html)

As indicated subtly above, for those hoping to find employment in the field, the next step is typically graduate school.

Research suggests that a bachelor's degree in the geosciences is an important, but not necessary step in the educational trajectory of a professional geoscientist. AGI looked at the undergraduate degrees of master's degree and PhD holders in the geosciences and found that less than half of graduate-degree earners in the geosciences also have a bachelor's degree in the geosciences (42 and 10 percent, respectively), though almost all had an undergraduate degree in a science field (Gonzales & Keane 2011, 44).

During the 2009-2010 school year there were around 9,000 geoscientists receiving graduate level training (Gonzales & Keane 2011, 43). According to AGI, the recent spike in graduate enrollment might be explained by "the perception of a negative job market, especially outside of the core geoscience industries. This perception drives undergraduates into graduate programs, even though geoscience employment opportunities remain robust" (Gonzales & Keane 2011, 43). Around 1000 master's degrees are awarded in the geosciences each year, as well as anywhere between 500 and 1000 PhDs (Gonzales, Keane, & Martinez 2009, 2.27). PhDs in the geosciences make up only 3 percent of all degrees awarded in science and engineering fields annually (Huntoon & Lane 2007).

Over the past 20 years, the geosciences have achieved near gender parity, when speaking in relationship to degrees granted. Over the past several years, the percentage of geoscience bachelor's and master's degrees awarded to women has hovered around 45 percent (Gonzales 2009, no. 27). Women are less likely to earn a bachelors or master's degree in geosciences than the life sciences, social sciences, and non-S&E areas (Gonzales 2009, no 27). However, they are more likely to earn a bachelor's or master's degree in the geosciences than in computer science and math, other physical sciences, or engineering (Gonzales 2009, no. 27). Women are more likely to earn their PhD in geosciences than computer science and math, life sciences, physical sciences, and engineering, and make up around 40 percent of those whom are awarded a PhD in the

geosciences annually (Gonzales 2009, no. 27). Gender disparity in degrees awarded still exists at the associate's level, however: Women earn less than 40 percent of associate's degrees in the geosciences, despite constituting almost two-thirds of all associate's degree earners (Gonzales & Keane 2011, 39).

Geoscience workforce

Around 260,000 geoscientist jobs existed in 2008 (BLS in Gonzales & Keane 2011, 96). According to calculations made by Gonzales & Keane (2011), the Bureau of Labor Statistics expects a 20 percent-plus increase in geoscience jobs by 2018, to around 320,000 jobs. Because the majority of the workforce is within only 15 years of retirement, there is an urgent demand to attract and train more geoscientists into core occupations (Gonzales & Keane 2011, 96-97). If current trends continue, demand for geoscientists will greatly outstrip U.S. supply (Gonzales & Keane 2011). Geoscientists work in 4-year colleges/universities, university research institutes, other academic institutions, regulatory government, government research, government forecasting, other government positions, oil & gas industry, environmental industry, other industry, and non-profit research institutes (Gonzales & Keane 2011, 102). Women constitute only about 15 percent of those holding geoscience positions (Gonzales 2010, no. 33).

Many of the areas that women geoscientists work are considered highly masculine. Gloria Miller (2004) conducted an ethnography of women engineers on oil rigs in Alberta, Canada. She argues that "there are three primary processes which structure the masculinity of the industry: everyday interactions which exclude women; values and beliefs specific to the dominant occupation of engineering which reinforce gender divisions; and a consciousness derived from the powerful symbols of the frontier myth and the romanticized cowboy hero" (47). These processes work to marginalize women within the field.

Chapter 3. Getting to graduate school: Developing an interest in the geosciences, the decision to pursue graduate-level education, and choosing a graduate school

Cohen and Mallon (2001) argue that through the analysis of stories researchers can gain important insight into the complexities and vagaries of the modern careers. The term "stories" is used to refer to the "complex, baggy, sometimes contradictory, often circuitous accounts of their career that people construct in the course of research conversations or qualitative interviews" (Cohen & Mallon 2001, 50).

> In particular, [stories] illuminate the ways in which individuals make sense of their careers as they unfold through time and space, attending to both the holistic nature of career as well as to specific career transitions. Further, stories as discursive constructs provide insights into individual sense-making. Through such insights, the story-based researcher can build a rich, complex, multifaceted, and integrated picture from the perspective of situated individuals (Cohen and Mallon, 2001, 48).

Given that science career trajectories, and especially women's science career trajectories, are not linear (Xie & Shauman 2005), I see stories as an effective way to understand the motivations and processes that shape peoples' experiences as scientists.

In this chapter, I examine the stories constructed by research participants to explain their current status as graduate-level geoscientists. In particular, I focus on their explanations of 1) how they developed an interest in the geosciences, 2) their decision to pursue graduate-level education in the geosciences, and 3) the process of selecting a graduate program. I draw on existing data to contextualize my findings.

Because past experiences work to shape current experiences, it is important to understand the history surrounding research participants' involvement in the geosciences. I am especially interested in the role of cumulative disadvantage, as identified by Etzkowitz, Kemelgor, and Uzzi (2000), in shaping students', and particularly, women's experiences, in graduate school in the geosciences. In addition, it is important to understand students' motivations to attend graduate school, because these might help shape students' perceptions of their experiences in graduate school. For example, students who see graduate school as a means to an end might be less affected by negative

graduate school experiences than students who view graduate school as a valuable part of their academic career, and for whom discrimination and isolation might attack the core of their identity as academic scientists.

Developing an interest in the geosciences

Although we know that educational and occupational decisions arise out a complex interplay of a variety of psychological, structural, cultural, and situational factors (Eccles 1994), respondents tended to trace their interest in the geosciences to very specific, though occasionally, overlapping sources. Many of the factors that impact decision-making are not readily apparent to a situated individual. Thus, while this information is important for understanding meaning making, it must be understood as shedding light on only part of a broader much more complex story.

Nature/Environmentalism

Four respondents linked their interest in the geosciences directly to their enjoyment in the outdoors and/or their love of nature. Kevin, for example, painted a portrait of an ideal childhood, romping through the woods in his home state, as alighting his interest in the geosciences:

> I grew up in New England, in pretty rural New England, in Maine. And I spent a lot of time, free time, just throwing around outside amongst the woods, and the streams and things like that. So I was always interested in landscapes, and I took a liking to rocks and things like that. I was also interested in a lot of biology sorts of things.

When Kevin got to college, he was still choosing between a major in biology and a major in geology. He took a geology course first and "just went with that."

Similarly, Annie traced her interest in geology as arising out of childhood vacations to national parks, during which she and her family visited many "geological oddities." A junior/senior elective course cemented Annie's interest in the subject. However, when Annie enrolled in college she decided not to major in geology because of her perception that it was "too easy." Annie's logic confirms Hoisch's (2010) survey

findings that many college students view the geosciences as a low status field. Between her sophomore and junior years Annie decided to switch from a major in chemistry to a major in geology, after looking through her colleges' course guide and deciding that the geology courses looked more interesting.

Although Daniel's pathway into the formal study of the geosciences was circuitous, he traced his initial interest to his childhood experiences in the outdoors:

> My dad is a teacher. He worked in the oil field for a number of years in [a western state] while he was looking for a job teaching. And in doing so, we spent a lot of time out on the prairie, hiking around, and picking up arrowheads, and looking at bones, animal bones, on the prairie. I really always enjoyed being outside and doing that kind of discovery. And we moved to [another western state] and I started working with the search and rescue group down there when I was in high school, and again, that got me out on the rocks, and it got me really excited about being outdoors. And that's what I really loved, that sense of discovery and investigation and just curiosity.

I consider Daniel's pathway into the geosciences in more detail later in this chapter.

Ligia, a student from South America, pointed to her childhood involvement in the ecology movement to explain her career path. Originally, Ligia wanted to go to college to become an ecologist. Ligia's father, however, discouraged her from pursuing this career path.

> I said to my dad, "I want to be ecologist." And he said, "No, ecology is just for rich people." You cannot be ecologist. You have to make some money. Be in a magazine, be a doctor, or maybe you can be an engineer. And after that, you get some money and you can be an ecologist.

Just as Ligia was starting college, her university began a program in ecological engineering. Ligia enrolled in this major, as it enabled her to study what she wanted, without disappointing her father. During college, she found herself pulled to courses in the geosciences, and after college she joined a research group that conducted environmental impact studies.

Although not all of the respondents traced their interest in the geosciences directly to their love of nature and/or desire to protect the environment, this theme came up repeatedly in the interviews. Although not the focus of this paper, this created an interesting dynamic between and within departments. Some students opposed the oil &

gas industry because of their concern for the environment, while others did not find the oil & gas industry and environmentalism incompatible or, at least, were able to reconcile the two.

Family influences

Four of the respondents traced their interest in the geosciences at least partially to the indirect or direct influence of family members. Both Annie and Daniel were exposed to rocks on trips and/or nature walks they took with members of their family. Bridget traced her interests in the sciences, more generally, to her father, who filled her family home with books and maps. However, it wasn't until just prior to college, after discovering career options were limited for geographers, that Bridget discovered geology.

Ron, on the hand, was directly encouraged to study the geosciences by family members. The youngest of four geoscientists in his family, Ron grew up with geology: "I guess I've *always* been interested in it." Although Ron was initially resistant to majoring in geology because of its boom and bust cycle, the latter of which had torn apart Ron's hometown as a young child, Ron's uncle eventually convinced him to go back to school for a second time to earn a bachelor's degree in geology.

Other contacts

Milton was introduced to the geosciences by one of his golf students, a geophysicist. After Milton expressed interest in learning more about the field of geophysics, the student lent him books that he had checked out of his company library. Milton was so taken with the reading material that he decided to major in geology in college, prior to taking a single class in the field:

> I was just reading through [the books], because I was at a point where was I wasn't really sure what I wanted to do for college. I knew I wanted to get a college but I didn't know for what exactly and so when I read through those books, I mean, I didn't understand half the stuff I was reading, but it seemed very interesting to me. And so I said, "Wow, that's what I want to do."

After taking his first class in geology, Milton was confident he had chosen the right major: "Like as soon as I did my first geology course, I was 'Yep. That's it.' That's what I wanted to do."

Coursework

Many of the students in my sample, like Milton, reported taking their first upper-level geoscience course in college. This is not atypical. In the United States (where eleven of the graduate students in this study received their K-12 education), only four states require students to take earth science to graduate from high school and only eleven states count earth science towards graduation (Gonzales & Keane 2011). As a result, over two-thirds of students, and half of college-goers, graduate without upper-level training in the geosciences (Gonzales & Keane 2011, 1, 18).

Introductory geology served as the main "hook" into the discipline for four out of thirteen of the research participants. Three of these students enrolled in the course to fulfill a college or university science requirement. Ryan started school as a math major before switching to accounting. When it came time to fulfill his science requirement, Ryan chose geology because he thought it would be "easy." Not only was the course more challenging than he had originally thought it would be: It was also more interesting. After taking a second geology course (to fulfill his second science requirement), Ryan decided to major in the field. Heather and Evan also enrolled in geology in order to fulfill their universities' science requirements. Heather credited her professor and teaching assistant's enthusiasm as part of what got her excited about the field. Both Ryan and Heather found themselves drawn to specific topic areas (Heather, volcanoes, and Evan, glacial landforms), which they enrolled in additional courses to learn about prior to declaring geology as a major.

Through work experience

Cindy was introduced to the geosciences through her job at an oil & gas service company, where she worked for over half a decade as a lab technician. As soon as she began her new job, Cindy enrolled in college courses with the plan of earning a second

bachelor's degree in geology. Cindy thought that she might have sought a degree in geology earlier in life, if only she had known what geology was:

> I didn't even know what [geology] was until like my junior year in college. I really think I may have been more interested if I had any clue of what it was. But my parents really pushed me to go into biology.

When Cindy entered college, the geosciences were still heavily male-dominated: There was a 4:1 ratio of male to female doctoral degree holders, and a 2:1 ratio of men to women in terms of degrees held at the bachelor's and master's level. Biology, on the other hand, may have been viewed as a more gender-appropriate field, given that women had already made much headway into this field.

Discussion

Themes emerged from the research participants' discussion of how they developed an interest in the geosciences. Some traced their interest to time spent in the outdoors, others were exposed to the sciences (if not the geosciences directly) by family members or other personal contacts, while many were introduced to, and became interested in, the geosciences through a college-level introductory course to geology. Still one person became interested in the geosciences primarily through her work experience.

My findings are similar to those made by Mary Anne Holmes, Suzanne O'Connell, and contributors (2003). Holmes and her colleagues conducted focus groups of geoscientists in different phases of their education and careers. One question they attempted to answer through the focus groups was "what attracts people to become geoscientists." The largest portion of Holmes' sample credited their attraction to the geosciences to their undergraduate experience (categories included a specific class, teacher, or field trip; the atmosphere of the department; and/or a meaningful laboratory working experiences). In decreasing order, participants also credited their love of outdoors/subject material, family influences (which included travel with family), miscellaneous influences, and K-12 school-related experience or teacher, as attracting them to the geosciences.

Gender differences in Holmes and colleagues' findings were small. At most, there was a six-percentage point difference between men and women's responses. (Men were

slightly more likely to be attracted to the geosciences through their love of outdoors/subject material). However, two women said that they were attracted to the field to prove male professors who told "them that they did not belong in the field or could not become geoscientists" wrong (Holmes et al. 2003, 18).

In my sample, two men cited individuals who sought them out to engage their interest in the geoscience, while no women did. Although, given the non-representative nature of my sample, no conclusion can be drawn from this finding, there is a relatively clear research consensus that men are more likely to receive support and encouragement to go into the sciences than women (Brotman & Moore 2008).

The findings above have implications for policymakers and industry leaders focused on attracting more young people into the geoscientists. Evidence above suggests that giving students guided opportunities to interact with nature, for example through fieldtrips to national, state, or local parks, might help spark students' interest in understanding more about the earth, in particular, its geological formations. However, recent budget cuts and the ascendancy of a test-focused pedagogy may actually act to discourage schools, more than ever, from scheduling these types of field sites. Similarly, budget cuts and other restraints are also causing many universities and colleges to stop offering summer field camps (Gonzales & Keane 2011). However, if the field genuinely values increasing its workforce diversity, an effort must be made to reach as wide of audience with these experiences.

Evidence also suggests that introductory courses in geology may also get students excited in the field. However, the problem is that the majority of students will never take a fully dedicated geoscience course. (Children do receive some exposure to the geosciences embedded within general science courses in K-5 or K-8, with some taking a middle school course in earth science (Gonzales & Keane 2011).) Encouraging states to put more emphasis on the teaching of geoscience in K-12 is one way to increase the number of geoscience students. In addition, encouraging more colleges and universities to enact science requirements may also increase the number of students taking geoscience, and potentially, the number that convert into geoscience majors.

Decision to attend graduate school

In this section, I explore my respondents' motivations to attend graduate school in the geosciences. Student motivation to attend graduate school has received almost no scholarly attention, absent Desmondra Rios' 2010 dissertation. Rios (and teammates) collected interview data on 82 graduate students enrolled in doctoral programs in the humanities and social sciences to determine their motivations for attending graduate school.

First, Rios and teammates coded students' responses to questions regarding motivation to attend graduate school into 5 categories: sense of fit with discipline, intellectual satisfaction, occupational pragmatism, serendipitous events, and dispelling myths. Then, they quantified the number of students giving each response, and looked for differences in certain groups' responses by race and gender. They found that women were significantly more likely to cite dispelling myths/stereotypes about their group (a subordinate status category) as a motivation for attending graduate school than men. Racial minorities were significantly more likely to cite dispelling myths/stereotypes about members of their group as a motivation for attending graduate school than white students, while white students were more likely to cite feeling well-suited for the discipline or seeking intellectual satisfaction as motivations for pursuing graduate studies (both privileged status categories). Preliminary findings, accounting for intersectionality, suggested that white men were more likely to give intellectual satisfaction as a motivation than other groups, whereas minority women were more likely to report dispelling myths as a motivation for graduate school attendance than all other groups.

Rios' categories are helpful both for thinking about the reasons students give for attending graduate school, as well as how some of these motivations are attached to a position of privilege or a position of disadvantage. I extend Rios work in several important ways. One, I extend her analysis to look at student motivation to attend graduate school in the sciences, specifically the geosciences. Two, by sharing students' stories, I provide greater context to my respondents' motives to demonstrate the complexities of lived experiences and decision-making. Rather than giving one

motivation for attending graduate school, students experienced multiple pull and push factors into graduate school. Although Rios coded multiple motivations per interview, motivations were decontextualized, and considered separately from each other in analyses, preventing any analysis of their interactions.

My sample of students differs from Rios' in several important ways. One, the students in my sample came from departments in which men and women graduate students were equally represented. Although Rios considered department characteristics in her initial analyses, findings were null, and thus, department characteristics were not reported on. Two, the students in my study come from relatively elite graduate programs. Rios gives no indication of the status of the departments from which she sampled. Three, the students in my study are less racially diverse than the students in Rios' study. For these reasons, I expected more students to cite motivations linked to privileged status.

Findings

Many students in my study gave motivations for attending graduate school that fit into Rios' "occupational pragmatism" category: In other words, they cited an interest in "acquiring legitimacy via [credentials provided by degree] to ensure employment, status, or long-term stability," as one of their primary motivations to attend graduate school (Rios 2010, 81). Given the organization of the field, this is not surprising: A master's degree is considered a prerequisite to hold even most entry-level geoscience jobs. Thus, students looking for employment that will utilize their geoscience background (rather than say, a general business job), typically attend graduate school. Contextual factors like workforce conditions act on individuals to shape motivations to attend graduate school. In fact, for several decades, enrollment in the geosciences was correlated with the price of oil (Gonzales & Keane 2011).

Ron's story illustrates the difficulty of finding work in the oil & gas industry without a graduate-level degree. When in school for his degree in geology (he already had a degree in geography, earned several years earlier), Ron had made many efforts to seek out an internship or job in the oil & gas industry: He attended presentations that oil & gas recruiters gave on campus; introduced himself to recruiters after their talks, and

applied for company interviews. However, he had no luck finding a job or even an internship:

> The interview process really wasn't open to undergrads. Companies just weren't looking for undergrads. Unless you had a really high GPA and were already admitted to grad school, no one, you couldn't even interview.

It was only through a family contact, a golf buddy of his uncle in the industry, that Ron found a job which would enable him to draw on his dual-degrees: an entry-level prospector at a company that bought, sold, and leased mineral rights. Ron accepted the job with the understanding that he'd be assigned projects that would enable him to learn and grow as a geoscientist, and, at first, that was very much the case. However, after a year or two, Ron began to feel that he had exploited the opportunities the job had to offer, and was no longer receiving the mentorship he has been promised. In response, he began submitting applications to oil & gas companies. However, even with three years of professional experience directly related to his degree (and earned from an oily school), Ron did not garner any interest from the companies. He suspected it was because he hadn't received a graduate degree.

> I was looking for a full time job. That was my main thing. But I noticed no one was looking at me because I didn't have a master's. Even with three years experience, it just wasn't happening. So I just made the decision that I've got to go to grad school. If I don't go to grad school, I can't... I don't know what's going to happen. But I knew if I did go to grad school, then I would have a lot more control over my future.

For Ron attending graduate school was "purely a professional decision," made in response to job market conditions.

Ryan best matches the typology of an occupational pragmatist. He graduated college with a degree in the geosciences and entered graduate school to open doors to employment opportunities in the field:

> I thought if I went to grad school it would get me up to a better pay grade and it would make advancements and promotions easier. It's a smart sort of career choice.

Because he was only motivated to attend graduate school to "get a better job," Ryan did not feel the "sense of fit with the discipline" that many of his friends did, which made it both difficult to complete the program, as well as to relate his problems to his peers:

> Everyone sort of struggles. Everyone sort of has hard times. But I find that most people are really strongly academically minded, and that even though it's hard at times, they really, truly enjoy it… I feel like I'm a little bit different than all of my friends here cause I just really want to get a master's, so that I can get a better job.

While other students were able to draw on personal resources to make it through the "struggles" and the "hard times" that mark many people's graduate school experience, such as their love for their research/a strong interest in the geosciences, that Ron exhibited, for example, Ryan did not have these to fall back on. Ryan's example demonstrates that the interaction, or, in this case, lack thereof between motivations to attend graduate school is essential for understanding students' graduate school experiences.

In some cases, the goals one wants to achieve in graduate school are different from the practical reasons that shape the decision to go to graduate school. Julia hoped getting a master's degree in the geosciences would increase her chances of being hired by the oil & gas industry. She designed her educational experience around achieving this goal, adding certain courses at the behest of her internship mentor and attending most of the industry recruitment events hosted by her department, of which there were many. However, getting a job in the oil & gas industry was not the reason that Julia had decided to go back to graduate school. Upon graduating college, she planned to work for a few years, and then decide if she were ready, or wanted to, get a higher degree. Self-induced unemployment, however, compelled her to apply much earlier than planned:

> I just kind of hung out around the house for a year and didn't get a job (laughs). So I guess now is later and I'm going go to grad school.

Although Julia did not claim agency in her decision to return to graduate school, denoting her return to graduate school as the result of a "serendipitous event" under Rios' coding, placed in context, Julia's privileged position becomes clear. She had not tried and failed to get a job, which meant a necessary return to school to increase her credentials; rather, graduate school was a readily available option to her when she decided not to join the workforce immediately.

In fact, many of the graduate students spoke from a privileged position when sharing their motivation to attend graduate school:

> To be honest, there weren't a whole lot of job prospects for an undergrad, especially from a liberal arts college with just a geology degree that I would have really been interested in doing long term. I was towards the top of my class in geology and it seems like that's what people do, they should go to grad school. I decided that I was interested in structural geology. And I was really interested in the details and pursuing specific projects, so I figured grad school might be a good idea.

Although this student is clearly weighing the availability of job prospects for a bachelor's degree holder in the geosciences in her decision to return to graduate school, she also senses that going to graduate school is the predictable next step, or "what people do." However, although the percentage of Americans with graduate-level degrees is increasing, jumping 2 percentage points in only ten years, graduate-degree holders still account for less than 1 in 10 Americans (Committee on Gender Differences in the Careers of Science 2010). Graduate school attendance and persistence to degree are related to academic and social integration within the undergraduate institution as well as characteristics of the undergraduate institution, such as rank (Ethington & Smart 1986; Zhang 2005). In turn, characteristics of the undergraduate institution are highly related to background characteristics of the students attending them, such as parent education-level and family income (Zhang 2005; Mullen, Goyette, & Soares 2003). Through mediating effects, family background plays an important role in determining who goes to graduate school.

Students can have multiple reasons for attending graduate school. In addition, motivations for pursuing a graduate-level education can also change through time. Milton graduated with his bachelor's degree in geology and helped on a geological survey for nine months before returning to graduate school. (The break between undergrad and graduate school had been planned). Milton credited two separate motivations for continuing on for his master's: his undergraduate internship experience and the desire to gain more exposure to the field. Although Milton enjoyed the opportunity to be an intern as an undergraduate, his experiences at both companies made him wary of the type of work to which bachelor's-level geoscientists were constrained (occupational pragmatism). In addition, Milton saw graduate school as a chance to continue exploring a field that he had been interested in since high school (sense of fit, intellectual curiosity):

> In the field of geology, there are a bazillion different things you can go into and specialize in. In undergrad it was kind of like I was getting a small taste of all these different fields. And I really liked digging around in all these fields, but I didn't know exactly what I wanted to focus on. So that sort of sparked my interest in pursuing a master's degree. I kind of wanted to use the tools that I've learned in my undergrad. The analogy that I like to use is: When you're in undergrad you're introduced to all these different tools and when you're in grad school and you are doing your master's, you start learning how to use these tools and you actually apply these tools to a research project or applied project…That was really what sparked my interest in pursuing the master's.

When it came time to decide whether or not to pursue a PhD, occupational pragmatism played less of a role in Milton's decision. Although Milton's advisor had convinced him that later down the line, a PhD would serve him well in industry (a career option Milton was weighing heavily against a teaching position), by now, the decision clearly rested on his sense of belonging in the discipline and his desire to continue pursuing research of interest.

> And then sort of halfway through my master's degree I kind of got bitten by the PhD bug. I was like, "Wow. This is, I could totally see myself pursuing research." I did a lot of research in my undergrad years and that kind of triggered my interest in research at the graduate level. So halfway through my master's research project I kind of said, "Look, okay, I think I can do this for another 3 or 4 years."

While almost all of the students in my study returned to graduate school out of occupational pragmatism (a neutral category), a sense of fit with discipline, or intellectual curiosity (privileged categories), three respondents, all women, stood out in their motivations for attending graduate school.

Ligia was encouraged to return to graduate school by her supervisor/mentor at work. He thought having a graduate degree would be necessary if Ligia wanted to continue conducting environmental research for the government. Ligia did not view her decision to attend graduate school as one made for personal gain, but rather, as a response to a higher calling to serve her community:

> I'm coming here because the best universities are in the United States and I can really do something more for my country. I really want to come back to my country and do something for them.

Ligia was grateful for her life back in her home country. She felt like she was giving up a

lot to study in a foreign country, around people she didn't feel accepted by. Without a sense of responsibility to her country, she may not have agreed to leave her job, family, and boyfriend behind.

Two other women reported experiencing strong "push" factors to attend graduate school, mainly traceable to their workforce experiences. Bridget had always planned to return to graduate school to earn a PhD (she already had a master's degree); however, it wasn't until she became unhappy with her workforce situation that she determined it was finally the right time. Rita didn't like the town to which her job had resigned her, and was beginning to feel that her work duties had grown stale and she was no longer learning and growing in her job. In addition, Rita had a poor relationship with her male supervisor, whom she "didn't trust." For example, Rita had met with her supervisor to do a practice run-through of a presentation she was making to several important people in the company on her own research. During that one-on-one presentation, she confided the limitations of her research to her supervisor. During the Q&A portion of her actual presentation, her supervisor brought up these limitations, presenting them as if it was he, and not Rita, who had noted them. He both undercut Rita's work and plagiarized her ideas in order to impress his bosses.

> It is just very frustrating in that environment where your line manager…manages your performance reviews which affects your pay raises and also how the other managers see you and what goes officially on file, just to have all that...and you know access to training approval, to have all of that in the hands of somebody who you don't essentially trust and you see to be taking from you sometimes and perhaps not necessarily giving to you, which is very uncomfortable. So I was not sad to see the back of him.

Cindy, whose story is illuminated in more detail later, also had a poor relationship with her male supervisors, and, in addition suffered from maltreatment by some of her coworkers. Cindy and Bridget might have been driven out of the S&E workforce by their poor work experiences. However, the "extra stuff" that women career scientists face (Pattatucci 1998), such as lack of support by male colleagues, compelled Rita to follow her original plan to go back to school. Similarly, the "extra stuff" compelled Cindy to get a bachelor's degree in geology, and further, to seek a master's degree in geology, in an effort to combat her self-doubt as a scientist, which had been exacerbated by her hostile

working environment. Although she was there to obtain legitimacy and to further her career options, Cindy's return to graduate school went beyond that: It was as if it was part of a self-healing process, which was allowing Cindy regroup and prepare to re-face the work world with a greater sense of self.

Discussion

Given that students need significant resources to get into an elite graduate program, it is understandable that the students in this study gave motivations for attending graduate school that aligned with Rios' "privileged status" category.

There were six students with previous work experience in the geosciences (Milton is excluded, because returning to graduate school had always been part of his plan). The primary motivation for returning to graduate school for three of them was occupational pragmatism. While the other three returned to school to improve their employability prospects as well, two, both Bridget and Cindy, cited their previous workforce experience as one of their primary motivations for returning to school. As discussed later in the chapter, for Cindy, returning to school was important for shoring up her sense of confidence in her abilities and knowledge, and for making her feel as if she deserved a job in the field.

As we will see, women who had experience in the workforce prior to returning to graduate school tended to be sensitive to the challenges and bias that women may face as members of the geosciences, while the other women appeared optimistic about their chances of succeeding as a woman in the field. This finding will be discussed in greater detail in Chapter 5.

Choosing a graduate school

In this section, I examine the process students went through in selecting a geoscience program.

Knowing the lay of the land: MA students choosing a PhD program

Students with a master's degree had already been through the process of applying for graduate school. They knew what it was like to be a graduate student and to be a member of the field. Thus, these students had a wealth of experience and knowledge to draw on when it came time to apply for a PhD program. They were more aware of what they wanted to specialize in, and who was working on these topics in the field. They also knew what they liked and didn't like about their current program. From the programs' perspectives, students who had already succeeded in a master's program were somewhat of a proven bet, less of a risk for an advisor to accept and fund.

Four of the students went to different universities for their master's and PhDs. Two of these students had worked after receiving their master's degree, and thus, the switch seemed natural: The students were no longer closely tied to their previous program and their interests had shifted, or become clearer, in the interim. Only two respondents switched programs with no interim.

Before switching to the geoscience program at Midwestern University, Evan received a master' degree at a school on the west coast. He liked his master's program and had formed a good working relationship with his advisor, with whom he co-authored a paper that was very well received in the field, garnering them both significant attention. However, around the same time Ryan graduated with a master's degree, his wife received her PhD from the same program. She was unable to find a post-doc at or near the university they attended. They decided to move to a new city that would have opportunities for both of them.

It is common for academics to be married to one another. Being in a dual-academic couple has an important impact on career paths, and especially, women's careers (Schiebinger 1999, Schiebinger, Henderson, & Gilmartin 2008). In one study, Schiebinger and colleagues (2008) found that while many academic partners viewed their careers as mattering equally, when one career came before another's, typically husbands' careers were put above their wives'. Given that Evan was successful in his current program, it might have been somewhat unique for him to follow his wife to a new department. However, the move came at a convenient breaking point in Evan's

educational trajectory, the end of his master's degree, and also marked a transition to a more elite program than he had attended in the past. Had Evan needed to take a step backward in his career, it is unclear whether or not he would have agreed to move.

Rita switched programs to work with a mentor who more closely matched her developing interests. However, her master's program also wasn't the right fit for her. Rita's environmentalism pitted her ideologically against the oil & gas industry, to which she referred at one point as the "enemy." However, at her old department there was a "big push" to, at the very least, entertain the prospect of working in industry:

> There were a lot of a lot of feelings from the school that we got a lot of oil money, a lot of our research or a lot of the things that we had at the University for the program had come from the oil industry, and so we needed to at least have polite discourse with the oil guys when they were there. Go to their talks and go out to lunch with them. So I don't know that there was really the expectation that we go into oil but we were at least strongly asked to consider attending functions at which they were providing goods and services.

Gender relations were also strained at Rita's original graduate program. According to Rita, her advisor, a woman, was eventually pushed out of the department because of her sense of isolation among the, older, male faculty members. As one of only three female faculty members, she experienced the classic sufferings of a token female minority in a male-dominated setting (Kanter 1977, Yoder 1991).

Three students stayed at the same university for both their master's degree and PhDs. Two of these students credited their relationships with their current advisors for their decision not to switch programs. Milton had been advised not to stay at the same institution for his undergraduate, master's degree, and PhD:

> Most of the people that I spoke with highly discouraged me from continuing, from getting all three degrees from the same school. Their reasoning was that you kind of become stale. Your research becomes stale. You kind of get too comfortable in your research world. Most of them were advocates [of leaving] your comfort zone, so moving to a new place and starting a new project and working with a new person.

However, Milton had a strong relationship with his advisor, who knew him well, having mentored him over many years. Milton felt his advisor was dynamic enough and his research interests broad enough that his advisement would never become "stale." In

addition, a reorganization and expansion of the department meant that Milton felt he was in a very different program than the one in which he had started.

Kevin also cited a strong relationship with his advisor as the reason for not switching programs between his master's and PhD. Explaining why he had decided to stay at Southwestern University, Kevin said, "I knew that I had a really good relationship with my advisor here. And after having been a graduate student, I knew that was really important, so I didn't see any need to rock the boat and try to establish a new advisor/advisee relationship at that point."

The advisor/advisee relationship is important in any graduate program, but especially in the geosciences. Students in the geosciences often receive their tuition and stipends through grants managed by their advisors, meaning that funding was often at stake if students decided to switch advisors because of a poor mentoring relationship. Students who receive funding through an advisor may feel pressured to move with him/her if the advisor accepts a position at another institution during their degree program. This was problematic because it could push students' graduation date behind because of logistics, like needing to meet different coursework requirements. It also meant uprooting one's home and forming new relationships with faculty members and students. No students in this study moved with an advisor, though one was asked. For this individual, finding a new mentor was difficult, and this challenge is covered in Chapter 4.

How students choose a graduate school

Students used the following methods to identify graduate programs that might be a good fit: talking with undergraduate advisors and professors to identify programs and/or professors that were forerunners in the topic/area of interest; conducting Internet searches of programs and looking at professors' CVs to identify people/programs with the same topical or methodological focus; networking at geoscience conferences to learn about and/or potential advisors/match programs; and/or contacting professors and students directly at potential match schools. Students typically visited the programs they were accepted into and met with potential advisors and current graduate students. These visits played an important role in shaping research participants' attitudes towards programs and in helping them to make their final decision about which program to attend.

This time intensive process of investigating programs yielded important data. For example, Rita found out that one of the professors she was interested in working with would be on sabbatical the following year and would not be accepting new students. Ron found out that two professors were leaving one of the programs to which he applied, meaning the program would no longer specialize in his research area, nor, come fall, would anyone on the faculty even do research in that area. Annie avoided several potential toxic advisor-advisee relationships by meeting with professors face-to-face and seeking out their students for insider information. At one departmental-sponsored dinner students told Annie, rather bluntly, to turn down the department's offer of admission: Her would-be advisor was always traveling, did not allocate time for students, and refused to assist his students in the job search. Annie's meeting with the professor confirmed much of what the students had shared with her. Another professor spent their short introductory meeting answering phone calls and checking his e-mails, a good sign that he would not commit time and energy to working with Annie if and when she enrolled in the program. A third professor was perfectly nice and interesting, but others confirmed that he was close to retiring from his position. This would mean, at the very least, finding a new professor within the department to advise her, or, at worst, having to start over in a new program.

In the end, Annie chose the geoscience program at Midwestern University. It was there that she felt the greatest connection with her potential advisors. She also had the opportunity to have a female co-advisor, which was important to her:

> I guess, in the geosciences there are not many strong female role models in positions of leadership. When you look at the make-up of faculty across the board especially at R1 institutions, maybe there's a female professors, maybe 2, maybe three. I mean at Midwestern, we are very, very good compared to a lot of schools in the country. Having gone to a woman's college, I just felt like it was very important to have that type of mentoring throughout my grad career. Because it's a completely different ball game, and it's a very different perspective and it's completely different challenges too, so I thought that having a female advisor would better prepare me that way.

According to Annie, she privileged the "intangible" things, the feelings she got, in choosing a program.

Annie wasn't the only student who privileged the intangible things about the programs she visited. Students were cognizant of the important role advisors would play in making (or breaking) their careers, and thus, were highly attuned to the way they treated them and what other students had to say about them.

Students also judged programs based on the impressions they formed about students in the department from their visits:

> I knew from my master's if you didn't get along with the people you work with every day and if you didn't have a close connection with them it was never going to work out right.

Science is a team-, rather than a solo-activity, making the relationships formed with fellow graduate students not only essential to the individual, but also his or her academic success, a topic I will explore further in Chapter 4.

Program rank also played a role in decision-making. While program rankings have been criticized for not accurately conveying educational quality and misaligning universities/programs from their mission as they strive to improve on indicators like donor funding, rankings have important consequences for departments and their students. Schools and programs with high rankings are better able to attract funding and other resources. They may also be able to attract better applicants. Whether or not the ranking conveys accurate information about a program in the first place, the ranking may lead to substantial program improvements and tangible benefits for students. For example, students from high ranked schools may have more job interviews and earn higher salaries than students in lower-ranked programs, even when controlling for qualifications (Stock & Alston 2000).

Ryan was admitted to two out of the three programs he applied to, and chose to go to his "reach" school, citing the U.S News & World Rankings: "I didn't feel like I could really turn down the opportunity to go to [this school]." Bridget cited the prestige of the professor that she would be working with, as well as the reputation of the university, as two motivations for selecting Western University's program.

Other students privileged their program's relationship with the oil & gas industry in choosing schools. As I will discuss later, some universities have symbiotic relationships with the industry, accepting industry funding to support students and faculty

research, in return for enabling companies to recruit heavily from their program. Of the four universities in my sample, three had strong ties to the industry, while one had a semi-adversarial relationship to the industry. Students who attended so-called "oily schools" knew that doing so would improve their chances of getting internships and making contacts that might lead to a good job in the industry. The reputation of these programs made them more desirable candidates to industry recruiters. Cindy had her heart set on Western University because of its reputation as one of the best geoscience departments within the oil & gas industry:

> When I went to the Society of Petroleum Engineering conferences where they'd send me to go to talk about [the company she worked for] and be the booth bunny, groups of students would come by from [Western University], all the engineers. And people would be like, "*oh, those are the kids from [Western]*." And throughout the industry, it has a really good reputation as being the place you want to hire your workers from. It was pretty much, you get a degree from there, and you get a good job. And if I was going to go back to school and take the risk of being poor again…

In fact, the legend of Western was so strong at one recruiting event (plugged as an "informational event") I attended, one recruiter complained that students from some schools, and one school in particular, "think that they don't have to do anything" to impress recruiters. He lauded the students in the audience for showing their dedication to working in the industry by attending the event.

Finally, location and funding played into students' decision-making calculus. For example, Kevin wanted to live in a place where the stipend to cost of living ratio would not put him into great debt and where the climate was comfortable. Both Bridget and Cindy were looking forward to moving to a new place. Bridget had always planned to use graduate school as a time to explore a new country. Funding ended up being the determining factor in two students' attendance decisions. Julia was deciding between two universities that offered full-graduate support when State University offered her a $9,000 signing bonus, a perk that helped her make a decision. Although he was very happy to go there in the first place, funding helped make Daniel's final decision clearer.

Summary

Students conducted an immense amount of research into selecting a graduate program. In choosing a program, they privileged the following: expertise of faculty; impressions of faculty and students in the department, especially of potential future advisors; program rank; funding; and location. For the most part, men and women privileged the same factors in assessing and selecting graduate programs.

However, gender did shape selection factors in some important ways. Drawing on her experience attending an all-female college, Annie recognized the importance of having women mentors in her life: Although it was not her primary motivation for selecting Midwestern University's program, the percentage of women on the faculty did play a role into her decision. Annie's experience in an all-girls school also changed her approach to graduate school, which I will explore further in Chapter 4. Lack of female faculty members at Rita's master's program was not the primary reason Rita switched programs, however, her experience in her master's program did effect what Rita looked for in her PhD program. Finally, Cindy's poor experience in the workplace led her to seek out one of the best programs in her field, as a way to gain a sense of legitimacy.

Circuitous paths into the geosciences

So far in this chapter, I have examined how people develop their interest in the geosciences, their motivations for attending graduate school, and the process through which they selected a graduate program. Many students' pathways into the geosciences were relatively traditional: students developed an interest in the geosciences, pursued a bachelor's degree in the field, and then went on for higher education, with some taking a short break between their upper-level degrees to work.

Below, I share the stories of two respondents whose educational and career trajectories veer far away from the "traditional pathway," in which students enroll in school, choose a major, graduate, and find a career in that field. This is the model assumed in reports relying on the pipeline metaphor. In many ways, Daniel and Cindy's experiences better illustrate of the missteps, turns, and happenstance that mark many scientists' educational and career trajectories (Xie & Shauman 2005) than the experiences

of respondents like Milton, who knew from a fairly young age (as a high school student) what he wanted to study and pursued that end in a relatively unwavering course. Analyzing Daniel and Cindy's stories gives a new perspective to how gender shapes students' experiences in graduate school in the geosciences than aggregating responses and comparing group experiences. The use of in-depth interviews provides a special opportunity for researchers to gain insight into individual experiences and how documented societal processes work to shape them in unique ways.

Daniel's story

When I interviewed Daniel, he was several years into his PhD program. He was in his thirties and had an extensive list of educational and work-related experiences.

Daniel grew up in the southwest. As a kid, he spent a lot of time in the prairie, hiking and hunting for arrowheads and dinosaur bones. Daniel was more than halfway through high school when his family moved to another state for his father's new job. The move unsettled Daniel's plans, while at the same time providing him with exposure to new opportunities. For example, upon moving, Daniel discovered and joined a search and rescue team. Daniel's search and rescue experience increased his interest in being in the outdoors and helped to further an interest in science and medicine. Secondly, the move meant that many educational doors shut to Daniel. His new high school had far fewer resources than his old school. When he enrolled, Daniel discovered he had already taken every advanced course (e.g., Advanced Placement courses) that his new school offered. Because there was little else for him to do, Daniel "piddled around" his senior year, taking courses that sounded interesting to him, even if he did not find them to be challenging.

When he enrolled in shop class, Daniel had low expectations. However, once in the course, he discovered he truly enjoyed it. He found out that he was good at working with his hands, and he liked figuring out how to fix things. One day a recruiter from a local technical college came to Daniel's classroom to promote its certification program for diesel mechanics. Daniel and a friend talked each other in to applying to the program. Daniel applied, got accepted into, and signed up for the program. Daniel's friend,

however, enrolled in a four-year program to please his parents. Daniel attributed the decision to attend the certification program to being young and aimless:

> That's what kind of drove it, was boredom initially. And then it sounded like fun, sure, why not? I was in high school. I had no clue what I wanted. It was a six-month program, so it wasn't like it was very long.

After graduating with his certification, Daniel took on a series of odd jobs, for example, working at a repair shop. After a lay-off, Daniel applied to work on a seismic crew. He liked the idea of working outside and doing body-labor intensive tasks. However, when he mentioned his previous work experience and his technical degree during the interview, the company hired him to maintain and fix their seismic equipment instead.

Daniel laughingly refers to his twenties as his "military experience": "It's where I learned discipline, and where I learned responsibility, and all those things that people say they go into the military for." Daniel felt that these experiences were of value, but couldn't imagine spending his life going from job to job, with such little stability.

Drawing on the interests fostered through his search and rescue team experience, Daniel applied to an emergency medical technician program at a community college in his late twenties. While he enjoyed the program, he found himself emotionally drained after working with patients and their families. Daniel decided to study forensic anthropology instead, because it drew on his interests without making emotional demands. As Daniel learned more and more about fossils, the importance of understanding the "dirt" they were in became apparent, and he signed up for a geology class. Daniel loved the course and learning about the field. His geology professor saw potential in Daniel and reached out to him: He took Daniel on digs, designed small research projects for Daniel to work on, and introduced him to other professors, some of whom came from the state university.

Daniel made an easy transition to the state university when he finished his two-year degree. He already knew many of the professors he would work with through their involvement in the community college. The professors were open to him exploring his interests and doing work that spanned multiple subject areas. Daniel graduated with multiple bachelor's degrees, one of which was geology, and work experience at a local museum.

When Daniel graduated with his bachelor's degree he took a job at the university as a lab cleaner. One professor who worked in the labs took an interest in Daniel, and spent time showing him what the equipment was and how to work it.

> And I've always been very good with manipulating electronics and working with those kind of instruments and so I had, he thought I had a very high capacity to produce some really good data, and so I started actually working as an assistant for him. And then he said "you should really stick around for your master's" and so I came up with a project and worked with him on that, and so the master's just kind of came almost fluidly out of working in the lab and becoming familiar with the techniques.

Daniel enrolled in the university's graduate program in the fall and was en route to graduate with his degree. Then, when all Daniel had left to do for his master's degree was his thesis, he was offered a full-time job in his field. With the blessings of his advisor Daniel left graduate school and began working. Originally, Daniel planned to finish his thesis while working; however, he ended up completing it during the first semester of his PhD program, which he started several years later. By the time I interviewed him, Daniel was a few years away from graduation, working part-time to support himself through the program.

Cindy's story

Like Daniel, Cindy's story illustrates that people's pathways into the geosciences are not always linear. Cindy's primary interest was biology. She had decided, at a relatively early age, as a high school sophomore, that she wanted to pursue a PhD in biology. She made it only partway to that goal, stopping with a B.S. Despite her desire to continue her education immediately, Cindy had decided that it was not in her best financial interest. She had financed her own college education and had graduated with student loans, for which she was responsible. If she pursued a graduate degree in biology, that debt would continue to grow. Cindy did not feel hopeful about the prospects of finding a job that would allow her to pay off such high loans, even with a PhD.

> I realized by the time you get a PhD in biology, you're 40 years old and then you get out and you have $200,000 in loans. And then your first job is only $40,000 a year.

Upon graduating from college Cindy proceeded to work in a series of laboratories in her field. One laboratory was housed within a department to which she was interested in applying; her idea was to vet out the department before she "signed on the dotted line to become a graduate student," making what could be as much as a nine-year commitment to the program. Although she loved the work itself, she felt overworked and underpaid, and began to question whether she liked what she saw as the biologist mentality.

> *I loved that job. It was great.* But it paid like 12 bucks an hour and I was working like 60 hours a week and no overtime. And I would come in at 10 a.m. in the morning, after being there until 9 p.m. and get in trouble for being late. And I'm like "Wait a minute. You're getting free work from me! I don't think you have a leg to stand on." It was just a really bad environment. And I don't get along with biologists. They're very martyr-like. You know you don't have any money or anything coming to you. And in my opinion everyone seems to be trying to see who is working harder and better than everyone else instead of, you know, enjoying life.

When the woman she had been hired to work under took a job at another university, Cindy opted not to move laboratories with her. Instead, she sought a job from a friend who was working in the lab of a service company to the oil & gas companies.

Cindy's experience at the service company was straining for several reasons. First, she felt she received unfair treatment from her supervisors. On one occasion, for example, she was called into a supervisor's office and scolded for talking too much. Later, however, management apologized:

> They actually came back to me later and apologized and to me about that, because they said, "We thought about it, and actually all of the guys in the department talk for hours on end and I think we just singled you out for that because you're a woman."

Another time, she was called in to a supervisor's office and reprimanded for not spending enough time in the lab. Her supervisor accused her of playing on the Internet in her office instead of working. In reality, Cindy had been assisting workers in other labs whenever she finished the tasks she had been assigned in hers. Despite the fact that Cindy had never received any feedback on her performance before, she now found herself on the chopping block due to lack of communication about her whereabouts. Several other times Cindy

heard via co-workers that her supervisor had asked her colleagues questions about her work ethic and performance.

Cindy's relationship with her coworkers could also be trying. She was the target of joking regarding her self-defined "liberal" politics and environmentalism, joking that sometimes crossed the line into harassment. For example, after 9/11 Cindy received death threats in her company mailbox.

Cindy's greatest concern was that she never felt secure about her work. She attributed this to a lack of on-the-job-training. Despite Cindy's genuine desire to become better at her job, she had difficulty finding people willing to help her figure out new equipment or procedures and was often left to resort to trail-and-error (errors for which she was reprimanded). Her repeated requests for support were typically ignored:

> I realized that I wasn't going to learn. I mean, there was no training. The training was kind of throw you in, sink or swim.

Cindy took advantage of her educational stipend in an attempt to gain the skills and knowledge she needed on the job and to get college credits for free. She took one course at a time while working, enough to bring her close to a second bachelor's degree in geology.

During her tenure at the service company, Cindy was moved out of her company's laboratories and into management. Although Cindy was happy about the move, it angered her that she felt she had received the opportunity not because her boss liked and believed in her, but because she was a woman.

> I really didn't like the fact that *almost all* the women in the laboratories were given the opportunity to move up into business. And I think that was [my boss's] sexism. It was working for me, but I didn't like the fact that I wasn't getting [the new job] because of my skills. I was getting [the job] because [my boss] was looking for a talkative person that would look good in a skirt to stand at the booth.

Cindy did mental work to separate herself from the other women working in the booth, drawing strength and pride in the fact that she had a science degree, and was able to handle technical conversations, and the others, whom she referred to as "booth bunnies," could not.

> I was happy that I had a science degree and I was there to talk about technical things and I wasn't just one of those… Because [my company]

> literally *had* booth bunnies, where they had no education, they were there to look beautiful. And they had their blond hair and their garb, and all that bullshit. And I'm a tomboy and I'm not like that. But I would try to talk with those girls...(sic). I couldn't have conversations with those women. They talked about shoes and fingernails and shit, and I don't talk about that.

The act of distancing oneself from others in order to maintain a sense of self was recorded by Goffman (1963) and has been captured in numerous empirical studies since (e.g., Kusenbach 2009).

Even in this new position, Cindy found that she struggled to meet the demands of the job. Once again, her employers asked her to complete tasks that she had never done before, with little support or training. When Cindy had the chance, she quit her job to finish her bachelor's degree and apply to a master's program in geoscience. Originally she had planned to stay in the same town for graduate school, but for various reasons (bureaucracy, clerical glitches, its poor ties to the oil & gas industry), she decided to apply to Western instead. It was important to Cindy to attend a program which would provide her with knowledge and skills that could be applied directly toward her future job: "If I was going to go back to school, I wanted to make sure I was learning directly something that would help me with my job, so I would feel prepared for once in my life, when I went out there to work. I was tired of faking it all the time."

Discussion

Not only do Daniel and Cindy's stories illustrate the complex pathways that people may take into the geosciences (providing further reason to abandon the pipeline metaphor when discussing the educational and career trajectories of scientists), they also help to illustrate many of the gendered dynamics that have been recorded in other studies of women in science, and women in professional work more generally. Daniel benefitted from multiple mentors during the course of his experience: the professor that reached out to him in community college, opening up learning and networking opportunities, and the professor took an interest in Daniel, then a lab cleaner, and taught him how to use the lab equipment and gained him entry into the graduate program, for example. Daniel's ability to connect with well-positioned mentors helped him get to the place he is today: a PhD

student in an elite graduate program in the geosciences. If these mentors hadn't reached out to him, it is likely that Daniel would have continued to switch between jobs and fields until he found a career that suited him.

Although she was the same age as Daniel, Cindy's experience in the geosciences was drastically different. She was relatively isolated within her workplace. She lacked support from her coworkers and her supervisors, who resisted helping or training her, despite the fact that she worked at the company for over 5 years. Cindy was largely on her own in seeking out opportunities for growth as an employee. It was her own drive that spurred her to get a second degree in geology, earning credits class by class. Similarly, no one from the field encouraged and/or supported Cindy to attend graduate school: It was a decision she made and goal she pursued on her own.

In effect Cindy and Daniel stories' serve to demonstrate how one's gender can help to shape one's experiences in the sciences. Like many women scientists, Cindy's career suffered due to lack of support and mentorship, and numerous forms of gender bias, some manifest, and others latent (Rosser 2004; Etzkowitz, Kemelgor, & Uzzi, 2000; NRC 1994). So too, did her self-worth, which she angled to repair by being more qualified (via attendance to one of the top programs in her field) than those surrounding her. This supports other evidence that suggests that if women do well in a male-dominated field it is often because they are more qualified than their male counterparts (e.g., Fox & Lawless 2004; Messner 2009; in Kimmel 2011). Daniel, on the other hand, benefited from the outreach and mentorship of multiple mentors. Whereas his career seemed more to fall into place, Cindy had to face many more barriers to get to the same place.

Conclusion

In this chapter, I explored how students from four elite programs 1) developed an interest in the geosciences, 2) their motivation to attend graduate school in the geosciences, and 3) their decision-making behind choosing a graduate program. In addition, I shared the full stories of two students' interactions with the geosciences up to the point at which they began graduate school, to demonstrate how men and women's experiences in the geosciences can, but certainly do not always, differ drastically.

Students provided a number of explanations for how they were introduced to and developed an interest in the field of geosciences, though they fit the general patterns identified by Holmes' and colleagues in their 2003 focus group study. Students also gave multiple reasons for attending graduate school in the geosciences, though many were driven into graduate school primarily out of recognition that a master's degree was necessary for being hired to basically any position in the geosciences. Although my study wasn't aimed at investigating this question, the fact that most jobs in the geosciences require a graduate-level degree might serve as a screen to exclude people whom might otherwise opt to major in or join the geoscience workforce. Even though funding for student support in the geosciences is high and continues to grow (Gonzales & Keane 2011, 90), the relatively low stipend received by graduate students often pales in comparison to what he/she could earn in the job market with a bachelor's degree, especially if the cost of living in the location where the graduate school is situated is high. For students with families or students with lots of college debt, the extra burden of graduate school might serve to keep them out of the field. Sax's (2001) finding that women who place high value on raising children are less likely to attend graduate school in the sciences, suggests that some women might avoid entering the field if armed with the knowledge that a master's degree in geology is a pre-requisite for attaining a job. Thus, this minimum education requirement may serve to exclude students in a way that quantitative models of people's educational and career trajectories in the geosciences are not able to assess: Some women (and others) may have opted out of the field well before ever taking a course or declaring a major in geology at the bachelor's-level. It is similarly difficult to assess how many women might have liked a job in the geosciences, but never considered it due to gender stereotypes about the appropriateness of the field to women. Even though women now constitute almost half of graduate students in geoscience programs, they are still outnumbered 3:1 in the geoscience workforce, which remains heavily typed as masculine.

Most students in my study, perhaps unsurprisingly, spoke from positions of relative privilege regarding their decision to attend graduate school. Some, for example, spoke about how graduate school seemed like a natural next step for them after graduating college or a fallback plan when other life events didn't go as they had

planned. Being able to go back to school, because one doesn't like his/her job, for example, is a luxury only available to a small section of the population. The ease with which most graduate students seemed to fit into the graduate school environment, discussed in Chapter 4, is also evidence that many had received the benefits of socialization into the academic world, for which many—even people with bachelor's degrees (think of students who sit at the back of classrooms with 500 students, whose professor and even, TA, might not know their names)—is far out of reach.

Several women in my study returned to graduate school for more complex reasons than to increase their ability to get a good job or for the opportunity to learn more about and do research on topics they loved; rather, they were driven to graduate school as a way out of poor work environments. Multiple studies suggest that women scientists may experience a "chilly work environment" which makes them feel unwanted, unsupported, and/or ignored by coworkers and supervisors, and as if their contributions to the workplace are not valued (Pattatucci 1998; Rosser 2004; Schiebinger 1998; Sprunt 2006). While the women in my study drew on these negative experiences to motivate their return to graduate school in order to seek a higher degree in the field, and the greater respect that generally follows the attainment of higher education, many other women likely abandon the field altogether, as suggested by data collected in an unpublished study by the women's oil & gas industry group, Prowess, and data on women scientists' attrition rates more generally (see, for example, NRC 1994).

The fact that some women already have negative experiences in the geosciences before entering or exiting graduate school contributes to Etzkowitz and colleagues' (2000) hypothesis that women in the sciences may experience "cumulative disadvantage." While at any one time the additional challenges or hurdles women face in their careers, or the discrimination they experience as women, might be slight and easily overcome, overtime these negative experiences may build up to effect women's success in important ways or to drive them out of the field. While those who spoke to their undergraduate experience in the geosciences were positive, small slights gone unnoticed might later be exacerbated, if not in graduate school, then the workplace.

The importance of forming strong relationships in graduate school, with other students and with faculty, but especially the advisor, was something many students

recognized and privileged in selecting a graduate school. Annie and Rita, however, also considered how they'd fit in *as women* in the potential departments. Annie drew on her undergraduate experience at an all-women's school to develop a consciousness of the importance of having women faculty to mentor her in graduate school. Rita drew on her experience as a graduate student in a department that was semi-hostile to women to select a graduate school that seemed like a better fit. While concern about being a woman in what remains a masculine-dominated field played into both women's decision-making, it is important to note that it was a factor, but not a determining factor, in which programs they eventually chose.

This is not to say that gender doesn't play into men's decisions in choosing a graduate school. Kimmel (2011, 1993) has pointed out that since men's experiences are often the norm against which others' are compared, we, as a people, and as researchers, tend to ignore that men have a gender and that men's gender has an impact on their experiences. In this case, being men frees male graduate students from asking the questions that many women might be compelled to in choosing a graduate program. Since geoscience faculties are overwhelmingly made up of men (Gonzales & Keane 2011), male graduate students never have to ask: Will I have the opportunity to have a same-sex mentor? Will I find someone who will be willing to mentor me, even though I'm a man? Nor do they typically have to ask: Will there be other men in my work group? Will I be the only man in my advisor's lab? They don't face these issues, nor is there any reason to think they may, so there is no need to consider them: Men's silence on the topic of gender in selecting graduate school is the very evidence of their privilege (Kimmel 2011).

Chapter 4. The Graduate School Experience

In the previous chapter, I examined the process through which students enter the geosciences. In this chapter, I explore students' graduate school experiences, again, with an eye toward how gendered processes might shape them.

Overall, many students were happy with their choice of field and their graduate school experiences. Departmental context, however, played an important role in shaping students' graduate school experiences: One department in particular seemed to engender cliquishness among its research groups and ill feelings toward professors. To the extent that they faced challenges in graduate school, many participants seemed able to draw on internal or external resources, such as their overarching interest in the field, or fellow graduate students, to overcome them, or at least, to lessen their blow. This, however, does not mean these negative experiences, more often reported by women, didn't add to the cumulative disadvantage noted by Etzkowitz and coauthors (2000).

This chapter is split into three sections. First, I explore the relationships formed among graduate students, considering the role that departmental context may play in fostering stronger or weaker relationships among students, and how perceptions of gender equality among graduate students might be just that–constructions that do not match their reality. Second, I look at student-faculty relationships, with a focus on the relationships students form with their advisors. Finally, I look at overt forms of gender bias some women (and some men, on behalf of women) reported facing.

Relationships among graduate students

Graduate school is a stressful time for many students. They are learning how to conduct independent research and how to act as professionals in the field. They must shift from learners of knowledge to creators of knowledge to succeed a process that can be difficult and anxiety producing. For the most part, they must learn to do this on their own. However, fellow graduate students can serve as important resources in navigating this difficult terrain, serving as sources of psychological and social support. Collaboration can help students meet the high demands placed on them; for example, students reported

collaborating on homework and on field and lab-work. More experienced graduate students are in a unique position to provide newer students with insider information on how to navigate the department and discipline successfully.

Traditionally, many studies have found women in the sciences have been cut off from these forms of support (Etzkowitz, Kemelgor, & Uzzi 2000). Many papers on women in graduate school in the sciences focus on the performance pressures, isolation, and role encapsulation that women often feel as the result of being one of the few (minority) women graduate students enrolled in a department or working in a lab (Kanter 1977, Etzkowitz, Kemelgor, & Uzzi 2000; Beoku-Betts 2004). However, many students in my study, including women, felt well integrated into the student body in their program. They talked about friendships and collegial working relationships they had formed with other students in their research groups or cohort.

Rita, for example, named her peers as the "best part" about graduate school. She and her friends kept each other informed about project meetings that might be relevant to each other's research, maintaining an open door policy. They also volunteered time to collaborate on each other's projects. For example, when I interviewed her Rita had just returned from a trip to Wyoming where she and six other students had helped a friend collect data for his study. According to Rita, the graduate students in her department provided a support system for learning new skill sets and knowledge and helped them keep their enthusiasm levels up: "It's fun to know that everybody else is interested in what you're doing and interested in contributing to that whole process."

From Rita's perspective, students in her master's program (not at Southwestern University) had been similarly supportive of one another. For example, when a student decided not to continue on to the PhD after his partner gave birth, deciding to look for a job in the oil & gas industry instead, his peers did their best to help him. To make him seem like a more desirable candidate to industry recruiters, Rita and friends started a local chapter of the American Association of Petroleum Geologists, to which they appointed the new father president. Rita did this despite being avidly against the oil & gas industry, which she described at one point as "the enemy."

Similarly, Annie also considered the "graduate community" to be the best part of her graduate school experience. She had met people across different disciplines and

research groups, who became both friends as well as professional colleagues. From her perspective, these friendships had been helpful in enabling her to grow as a geoscientist, and to receive much needed support as a graduate student: "I've learned a lot about geology just by being friends with other grad school students and learning what they're doing. It's a great way to transmit knowledge, as well as a really great social and support network."

In geoscience graduate departments, which are on average, 40 percent women (Gonzales & Keane 2011), there is also room to create large support networks of women. Cindy drew on her previous work experience in privileging friendship formation, and concentrated on building up a tight, strong network of female peers when she got to graduate school:

> I really focused on that. Because I think that was one thing I was unhappy about with my job at [the oil & gas service company she had worked at for over 5 years], because I didn't have a good support network.

In the end, this group of women had been critical to Cindy's success in graduate school, helping her cope with difficult advisor-advisee relationship and a challenging marital situation.

Only one student in my study reported feeling complete isolation from other students in her department. She traced her feelings of exclusion to being a women, but more so to her nationality, and the language and cultural barrier between her and the "Americans" in her program.

> I don't have friends in the department. I have friends outside of the department. Because the geomorphologists, they are all Americans. I cannot follow the same writ of conversation, because I'm an international student. I have more shared feelings with international students outside of the team. The people I talk most with are from Turkey, China, Korea, India. But with American people, it's much, much harder to have a connection because of the language.

Indeed, I could see the source of Ligia's frustration during the course of the interview, as we struggled to understand each other. Ligia was very self-conscious about her English-speaking ability, checking in frequently to make sure I had understood her.

The organization of geoscience departments themselves helped ensure that students formed close working relationships, if not friendships, with other students. When

I asked Milton if he had a chance to collaborate with other students, he shared that collaboration with other students was a necessary part of the research process:

> There's definitely a lot of collaboration with students. You can almost say that when you collaborate with faculty members, it's almost synonymous to collaborating with other students. It's usually is the faculty members that plant the seed and then it's the graduate student that take on the nurturing and the development of the plan, the research project…

Which research groups that students were in played an important role in shaping their social experiences in graduate school. Outside of class, it was often the only formal way for students to be introduced, and collaborate, in the department.

Departmental context played an important role in facilitating or discouraging strong relationships among students. Several graduate students (both men and women) complained that their departments could be "cliquish," with close relationships formed between students working in the same research group or on the same topic area, but little opportunity for students to spend time or get to know each other outside these groups. In fact, one Midwestern University student's advisor had noted this and started making an effort to invite students (and other faculty members) to his research group's events, hoping to help create a sense of connection among members of the department and to spur research ideas and collaborations that cross-cut individual topic areas and methods. All three students at State University reported what might best be referred to as an "odd vibe" in their department that impacted the relationships formed between graduate students, as well as faculty/student relationships. Students also noted that it took much longer to receive a master's degree in their program, 3 to 4 years, than other geoscience programs. Julia related that the first semester of her program was so disorganized, unnecessarily tough, and unfair to students (in one of many examples, one professor extended her course into the second semester to make up for classes she had cancelled, effectively increasing students' spring course load by one course) that while it forced close collaboration among members of her research cohort, it also turned students inward, some toward self-destructive behavior.

> I think a lot of people dealt with the stress by just drinking. I know two of the guys were pretty much at the bars every single night. And sometimes they'd be too trashed to make it home, and so they'd just crash in the lounge we had by our offices. And there was just alcohol flowing.

On the other hand students at Southwestern and Western University seemed generally pleased with the amount of time and quality of interactions with other students. The administration at Western University had invested a lot of time and money into increasing collaboration among science students from all minority groups. Said one student:

> I think Western University is definitely trying a lot of different tricks to try to improve things to the point that they can be improved upon, and that's also based on disability, and race, and any other kind of diversity that you could consider as well, not just women diversity.

Other researchers have similarly documented the important role of departmental context in shaping positive or negative experiences for graduate students (Uzzi, Kemelgor, & Etzkowitz 200; Fox 2001).

Both male and female graduate students perceived that they got along well with graduate students of the opposite sex. However, several interviews pointed to the continued existence of bias against women. It was common for students applying for internships and jobs in the oil & gas industry to share any news they received from companies with other students in their departments. Sharing information was often beneficial for helping others figure out the status of their own application: For example, if three people had received a rejection and one person hadn't, it was a good sign that he/she was still on the waiting list for an internship. Through student information networks, those applying to the oil & gas industry learned important information about individual companies: which ones offered interns a larger stipend, what types of projects companies were hiring interns or employees for, and the location of internship placements, for example. Given the value of this information, word spread quickly through the student grapevine whenever anyone received a rejection or acceptance letter. One year, Ali, a woman Ron had known since college and whom he considered to be a close friend, did spectacularly well in her interviews, receiving multiple internship offers from oil & gas companies, more than most other students in the department. According to Ron, this frustrated his male colleagues, who hadn't been as successful in receiving internship offers:

> People would be talking about the interviews we had, me and the other guys in my office, and someone would bring up, someone would say something, and I would be "Oh, Ali got an offer from them." And they were like "Oh, well of course she did. Because she's pretty." And I was like, "Well, she's really smart, too, and she's much more socially adept." I imagine being in an interview with her, she's great, whereas a lot of people aren't good at interviews. And there's a lot of…there's some of that there…where people kind of write people like her off, because, of course, she got this grade. She's Ali. And I'm like, "No, she's actually smart, and she works really hard."

Ron traced his male colleagues' reactions to Ali's achievements to "jealousy and probably a little male chauvinism." Other studies support that women's contributions or accomplishments are often downplayed in this manner (J.C. Williams 2006). Further, accusations of reverse discrimination can work to strip women of their well-deserved rewards (Rosser 2004).

> "Like of course I didn't get this offer and Ali did, cause she's a girl." And "this company only hires attractive women." And it's like, well, probably not, I think they hire men, too, but they're just not hiring you…Don't blame it on…

Ron recognized the irony in many of his male peers' statements. He and four other men had received internship offers from the same company, while not a single woman in his department had: "So you could also say that [large independent] only hires men… Which they don't."

Ron said that this same attitude towards women had not characterized his undergraduate department. He traced it to the environment of his undergraduate program, in which "everyone kind of supported everyone else. Everyone kind of studied together but there wasn't any competition for grades." This environment, as mentioned earlier, was drastically different than the one he had encountered at Southwestern University.

Similarly to attributing women's achievements to reverse discrimination, people may also question the fairness of programs designed to give women a leg up in what has been historically an unequal playing field (Rosser 2004; Schiebinger 1998, 85; NRC 1994, 23). Indeed, as an active organizer of programs for women on her campus, Bridget noted that some of the men felt it was unfair that there were "girls' clubs":

> I think a couple of the younger male graduate students, master's students, know that we have women's things and they always get a bit kind of silly

> about it, like, "oh, we can't join the girl's club," which I can understand, like, kind of feeling the same thing. Like in my undergrad university there's a gentleman's Friday drinking club and they have a specific tie and you have to be invited to join in order to… kind of initiation stuff. And women can't join that. And I think they're kind of stupid clubs to be exclusive like that. As I've explained, although they're women-focused, actually, men are welcome at the events. It's not anti-man, it's just pro-woman.

Rather than attributing these men's reactions to her effort to even the playing field for women to machismo or sexism, Bridget attributed them to their young age:

> That understanding is not there in the minds of a 22-year-old man master's student. And part of that I think I pick up on, because just being that I'm 5,6,7 years older, I'm a little distant from being in my early 20s of age and so I'm going to personally react a little bit differently. And I can be calm and just explain kind of, "You're being silly. That's not what it is, but if you think of it like that then you can, but it's not, it's actually not like that."

Ron and Bridget's stories are a reminder that "old men" are not the only ones to blame for bias against women in the geosciences, a claim I heard from several graduate students, and was promulgated by industry recruiters, as discussed in Chapter 5. Although norms, laws, and, to some extent, attitudes toward women's involvement in the sciences have shifted that does not mean sexism has disappeared.

Advisor/advisee relationship

Graduate students refer to faculty in their graduate programs in three different ways. One is "the department." The department is a relatively vague descriptor and generally used by students when they are looking to pinpoint a certain gut feeling or "vibe" they have received in their program, but which they cannot trace to a specific person or source. As I will explore further in Chapter 5, students often point to "the department" in explaining the pressure they feel to pursue a job in a research institution or to court the oil & gas industry. Two is "professors." When students talk about professors, they are generally referring to the faculty members with whom they've had direct contact through courses, research projects, or activities within the department, or professors who serve on their research committees. Three is the "advisor." The advisor is

the person with whom students interact the most and is the most important person in students' graduate careers. As discussed in Chapter 3, the advisor usually provides funding to his/her students. In many ways, students applied to an advisor rather than a department/program in seeking acceptance to graduate school. Because the advisor is the most crucial person in a student's career, I focus on them here.

Advisors played an important role in shaping the graduate school experience for students and protecting them (or not) from outside departmental pressures. A poor advising relationship can color a student's whole graduate school experience, while a strong advisor-advisee relationship can produce a confidant student and scholar. As I explored in Chapter 4, many of the students recognized the importance of identifying an advisor with whom they could work well. Some students, like Milton and Kevin, for example, made the decision to stay in their program primarily because they had established a good relationship with their advisor and decided, as Kevin put it, "not to rock the boat."

An advisor who was liked seemed to be one who was available for meetings, who had the students' best interest in mind in doling out advice, and who was willing and able to help guide his or her students' careers, but did not attempt to control them. Although Milton thought that "the department" as a whole, if given the chance, would steer him into a career and lifestyle he didn't want, he felt protected from external departmental pressures, stating "I'm blessed with an advisor that's very supportive with whatever decision I want to make":

> If I need a recommendation letter to apply for job with Exxon or with USGS or with Wendy's or whatever I want, he'll write one and be supportive of it. And of course he's provided his very, very good advice as far as the different kinds of jobs that I have in mind, for example, when I was debating… Before I made my decision to go for the PhD, I was debating whether I should go for a PhD or not and he asked me, "What kind of job do you see yourself doing or working as over the next couple of years?" and I said, "I'm leaning towards industry." He was like "Okay, industry is great. You don't have to have a PhD. You can get a job with big oil or get a job with whatever industry, but if you have a PhD it gives you several benefits that even the private industry will appreciate 10, 20, 30 years down the line. They may not appreciate it immediately right off the bat, but they will appreciate it on a longer time scale.

Because Milton didn't feel that his advisor was trying to steer him a certain direction for personal gain, he listened to and trusted in his advice. As Milton put it, his advisor simply provided him with "another way of looking at things." Ultimately, he left the decision up to Milton.

Kevin felt the same departmental pressure that Milton did, and again, his advisor provided the support he needed to pursue his own track. Although Kevin had secured his own funding, meaning he didn't need to work on his advisor's research projects for support, his advisor gave good advice and opened up many opportunities for him, for example, developing an opportunity for Kevin to work with a colleague in Germany.

Although Daniel's advisor was new, meaning that he knew little about how the department worked, or about how to steer Daniel through the program's various markers, that newness was also something that Daniel viewed as a benefit. He described his advisor as having "rose-colored glasses on." For example, his advisor had implemented donut breaks hoping to help weaken the borders between different research groups and to foster additional collaboration among students and faculty.

A number of women talked about the strong relationships they had developed with their advisors and the opportunities their advisors had opened up for them. For example, Bridget called her advisor "awesome" and talked about the strong level of support she had received from him and many of her committee members.

However, even with careful vetting some students ended up in a negative student-advisor relationship. Julia, spoke generally about the professors at her school, many of whom "are notorious for not letting students turn in their proposals early on in their research" and waiting as long as possible to approve their students' work. Julia felt many advisor/advisee relationships at her university were exploitative:

> Part of it's definitely publication. Also, I think, it's kind of cheap labor for their own research. Why do all the work yourself when you can have a grad student do it for you? And that way the professors can work on multiple projects at once. But a lot of the professors seem much more interested in their own research than in being advisors or mentors.

Although not put in this blunt of terms, at least one other student confirmed the atypically long time it took to graduate from their master's program.

The ease with which she was able to talk to her co-advisors was one of the reasons Annie had chosen to attend Midwestern University's graduate program. However, she soon found that her primary advisor was a poor match. He rarely allotted time to meet with her. The time he did spend with Annie was low quality. Her advisor bought his infant to the office, which made conducting meetings difficult. According to Annie, "It just got to the point where I was like, I really deserve better than this." Another bone of contention with her advisor was his enmity toward the oil & gas industry, a career option that Annie was actively considering.

Although Annie eventually found a new advisor, who was supportive of her goals, it was not without a risk or cost. Switching advisors meant that Annie also had to switch projects from her master's thesis to her PhD. Not only did this mean undertaking a whole new area of study, it also pushed her graduation date back by a year. However, for the most part, the stark contrast between her relationship with her old and new advisor had made the decision worth it:

> My new advisor, I think, is absolutely supportive of whatever I want to do. With the [oil company] internship offer that came up this year, I felt really bad asking for the time off to do it, because I wasn't planning to do an internship this year and I don't really have the time to do it. He was traveling, and I wrote him an e-mail. I was like, "this opportunity came up," and I explained the rationale of wanting to do it. And he e-mailed me back and he was like, "You know, you never need my permission to do what you feel you need to do for your career." So he said, "Go for it." Which is *so* supportive. But my old advisor, he, after I did my first internship I came back, and he was like, "Are you going to go into industry now?" And I was like, "I don't know. I really enjoyed working for them. It's a possibility. And he's like, "Well, it's not worth my time to advise someone whose going to go into the industry."

While, in most cases, the advisor worked to support students in their effort to achieve their goals, sometimes the advisor's plans for a student conflicted with the student's own plans for his or her life. This theme is explored again in Chapter 5.

Cindy also had a poor advisor-advisee relationship. She had been in school for a little less than a year when her advisor announced he had accepted a new job in another country. Since she had already started a research project for her master's degree, Cindy originally considered moving with him. However, several things made her reconsider. One, she had applied to the program because of its prestige and its connection to the oil &

gas industry, and she didn't want to give that up. Two, she began to see signs that the relationship might not survive the move. She watched as another student, there for a PhD, was dropped because she wouldn't move, even though visa issues prevented her from doing so. Another time, he e-mailed a student the night before his defense to tell him he wouldn't be there (due to a non-emergency meeting in his role as a consultant), forcing the student to defend his dissertation twice. This, combined with several instances in which her advisor verbally berated her, once in front of peers, helped Cindy make the decision to leave. Like Annie's decision to leave her advisor, Cindy's was not without consequences. She needed a new mentor to fund her; however, a new cohort had just started, the largest one ever in the program's history, meaning that Cindy was competing for limited advising slots with dozens of other students. Since it took her time to find a new place, she was now convinced that she was "going to be the world's longest master's student."

Ligia's relationship with her advisor wasn't toxic; however, she also didn't feel close to him. Ligia felt that as a woman, and as a non-American, she was unable to connect with him in the same way as his other students.

> I have been in U.S. for a year and a half, and during that time I had the opportunity [to go into the field]. My advisor had two graduate students. And he's always talking with *him,* not with me. And I think one reason is because I'm a woman. And two, because I'm an international student. Better relationships are always formed between a man and a man than a man and a woman.

Ligia felt that people formed better relationships that resembled them on major status characteristics. Indeed, research suggests that many professors (and others) engage in homosocial reproduction, choosing to work with people who remind them of theirselves—explaining for example, the difficulties in diversifying faculties (Dressel, Hartfield, & Gooley 1993). Although Ligia felt left out by her advisor, he did engage in concrete acts to support her career. For example, because she wanted to do research in her home country he agreed to add a new field site to his portfolio and was planning to travel there with her there to help get her fieldwork started. He had also agreed to use his

contacts to find her an internship in the areas she was interested in, because Visa issues presented her from going after many opportunities available more generally.

All thirteen students in my study currently worked with male advisors. Annie had started with a female co-advisor and continued to work with her on some projects. This particular woman was also a member of Annie's dissertation committee. Rita's advisor at her master's program was a woman, and had suffered from isolation as one of only three women faculty members in the department: She left the department around the time Rita did. Lack of female mentors has also been cited as one reason that women may fare poorly in the sciences, though Eileen Byrne (1993) cautions in her book, *Women and Science: The Snark Syndrome*, that there is little actual evidence to support claims that female mentors are better for women than male mentors. Byrne suggests that while women may benefit from seeing others whom have made it, they may also view their own plans for themselves as different than, and incompatible with, more experienced women scientists' choices. Not up for debate, however, is that women in the geosciences do lack female mentors, as women comprise less than 14 percent of tenure-track faculty and less than one-fifth of non-tenure track faculty, which is below the other S&E fields in general (Gonzales, Keane, & Martinez 2009).

Overt forms of gender bias

Above, I discussed how beliefs about reverse discrimination and misattributions of women's ability might bias some male graduate students against female graduate students. I have also suggested that the quality of relationships formed with advisors, which is often influenced by gender, race, and nationality, can vary widely, and that negative relationships with advisors can have an adverse effect on students' graduate

careers. Here, I discuss graduate students' thoughts on gender, as it relates specifically to their graduate school experiences.

Protectionism

In only once case did a student point out an institutionally-inscribed barrier to women graduate students' success. One woman told me that she had recently discovered that her department had rules in place to prevent women from going out into the field under the same conditions as men. When I asked her what the department's explanation was, she responded:

> As women we're seen as more…if there's a single woman working on instrumentation out in the field, she is more likely to be attacked or robbed than a man in the same situation.

This is not far from the concerns of Professor H.B. Woodward, whose fear "that women, when mapping in quarries and railway-cuttings, might encounter men, and not always polite men and even cock-fighting in Glamorganshire" was recorded in 1849 (Appleby 1979 in Burek and Kohlbl-Ebert 2007).

These rules affected women's ability to go into the field, because they were reliant on other peoples' schedules. This, in turn, may have, affected their ability to be as productive as male graduate students, who were not required to take anyone with them to their site. Said the same female graduate student cited above:

> I'm always, my schedule isn't always, the easiest to figure out, because I'm working on everybody else's schedule whereas it's advised for the male students to take someone else with them but it could be anybody, a girlfriend, a buddy, or they can go by themselves if they so choose. But the professor is like "You really should take somebody out there because it's safer." But for us it's a much stronger, like "you need to take out X, Y, Z person and take them with you so they can make sure you're okay."

Being taken seriously in the field

Women weren't always taken seriously in the field, a finding common among researchers of women in science (Rosser 2004). Ligia, for example, found that men tended to be listened to over women. In order to be heard, women had to be very

"aggressive." Women who act aggressive, however, aren't always responded to in the same way as men, a problem that often prevents women from being promoted or hired to leadership positions (Carli & Eagly 2001). Annie, however, felt that having attended a woman's college, she (and other women in her program who had also attended women's colleges) was more self-confident and assertive than other women in her program.

Rita felt that "older professors have a hard time taking younger female graduate students seriously," a feeling shared by other women in her program. Rita and her women friends had discussed that they felt unable to be friendly and "be a professor at the capacity they'd like to be." While Rita didn't explain this in more depth, women in professional fields have found that when they are "too nice" it 1) can be taken as a sexual advance/ sexual openness, or 2) can cause them not to be taken seriously as professionals. Indeed, the first had been mistaken before. Rita had met several well-established professors for dinner during geoscience conferences under the presumption that they wanted to discuss her work, only to find she was really on dates. A male student also brought up that women were sometimes targets at professional conferences:

> I don't want to call it sexual harassment, or something like that, but I think that it definitely goes on, I think that it's usually more at conferences where female graduate students are, you know, teased and things like that by drunken geologists. It's pretty common that geologist like their beer. That stuff goes on and it's a little bit unsavory to observe sometimes, but it occurs. I don't think it ends up generally becoming a huge issue or anything like that, but I'm sure if I were one of those female graduate students, I would be off-put by it at some point or another.

Although he was wary to call it "sexual harassment," this male student did not completely brush off the seriousness of how women graduate students might be treated, acknowledging that if he were treated that way, he would be "off-put" by it.

Women also reported problems being taken seriously by male colleagues or locals at field sites. Two women reported experiences wherein men at their field sites (in both cases, located outside the U.S.) wouldn't listen to them. One woman talked about how they were expected to follow local custom, which would mean that after her workday, she was expected to go home. Meanwhile, the men were allowed to stay out and network.

Some students traced gender discrimination against women in graduate school in the geosciences to "old men," preferring to think of their male colleagues (or in the case

of male graduate students, themselves, as well), as accepting of women in the geosciences. For example, the phrase "old boy's club" came up in several interviews to explain the field of geosciences, generally, or in one case, male faculty members. When men complained about her "girls' clubs" Bridget was reluctant to hold them accountable for male chauvinism; instead, she attributed their attitude to their young age: Apparently, men in her own cohort were incapable of the gender bias she noted in the geoscience workforce, so astutely. While one woman felt that she herself had not experienced gender discrimination, she mentioned that several older male professors were known for that.

Children

One student talked about bias against women graduate students who verbalized plans to get married or have children. Whenever she or other women graduate students mentioned either to faculty members, they'd "get a stern talking to about wasting our abilities on children." In fact, when one of her friends was having difficulties getting her male professor to respond to her, she told him:

> "If you don't talk to me about this tonight, I'm just going to go and get married and have babies," and he said, "There's nothing worse that you can say to me" and sat down and had a conversation with her right then.

The same stigma did not, she felt, exist against men.

> I don't think anyone thinks about it one way or the other when men have babies. You know it's just, "Oh, great, that's fantastic." It doesn't seem to impact their career in any way and no one seems to think it would possibly influence their, you know, the time that they can spend working or the amount of work that they're going to get done… It's totally unfair.

Effectively, this student noted the desire by department for the "disembodied student." According to Rita, professors believed women's research productivity would decline if they had children. Because professors assumed men would have a wife to stay at home with their children, they did not believe men's research productivity would decline. Thus, when men had children, it was not looked down upon; however, women were discouraged from having children and getting married (which, to many people, serves—correctly or incorrectly—as an indicator that children will soon follow).

Men who invest heavily in their family, however, might also be looked down upon. Bridget spoke of the disappointment the department felt about losing a promising young male graduate student who left after he graduated with his master's degree to follow his wife so that she could further pursue her career. J.C. Williams (2006) notes that not only women, but also men who prioritize children, can run up against the "maternal wall."

Being proactive for women

Bridget served on numerous committees, and was, or had been chair of several of them. Bridget was especially active in terms of creating opportunities for women graduate students to meet and learn from women in the industry, working with several organizations to bring various women representatives to campus to share their "strategies for success" and their personal experiences as women in a field that has been, and still is, workforce-wise, male-dominated.

Bridget was unsure of the effect of the speakers she organized for her fellow female colleagues. Speaking of one set of presentations she had helped to organize, she said:

> I've heard mixed reactions, and sometimes people… We had a panel discussion for the first meeting. One lady was talking about breastfeeding her children, having five children… she's a faculty member that's almost retired now, and being a mother to young babies in the 60s, and, you know, having to come back to teach after spring break because her baby was born during spring break and things like that. Sometimes people don't like to hear what is the truth of somebody else's experience. So I'm sure for all of the positivity that some people take from specific events and specific conversations with somebody with a certain experience, there's also confronting information, which people really don't appreciate, which kind of is factual but is a negative to take away, if you know something didn't work out or you can't have it all or essentially it's not possible to achieve balance or those are some of the negative comments we've heard out of the same forum. So I think for some people that will help them, but I think most of these decisions, honestly, are kind of a personal ongoing meditation and you just expose yourself to lots of different influences and work out what's right for you as an individual. And I think there are more variables within an individual woman than I think there is necessarily between a man and a woman.

Indeed, one student who had attended many of these presentations felt they minimized discussion of the biases women faced in the workplace, a theme I will explore in more detail in Chapter 5.

Bridget believed that in a male-dominated field, women must do what they can to support one another to succeed: “You basically have to beat the boys at their own game. And not being anti-man but just pro-woman.” Thus, when she stepped down as a leader of a campus organization, she nominated a woman successor. The woman was voted into office via democratic election; Bridget felt strongly that she wouldn’t have had the confidence to run, and ultimately win, if Bridget hadn’t put her on the ballot.

> That is a very equality based way of giving a woman a chance, because you know, if people didn't like her they would not have elected her. But it was just making sure that the nomination was there and I think we need more, more scenarios like that where people are at least given shortlist because if you throw enough mud at the wall some of it's going to stick, if we have enough women candidates to things, we will have enough women progressing to those targets, whatever they are.

She spoke about the historical injustice against women, as a motive for doing this, noting the high attrition rate of women from the sciences, that the majority of faculty are men, that men tend to control more resources, and lab equipment. She was aware of sociological literature on women in the sciences, as well.

> It's definitely not affirmative action because it's all election based, but in my case I specifically nominated a girl, because I knew it would make more difference in her career in five years time to have that experience then it would make to the boys because the attrition rate and sciences is so high for women. So anything you can do, it is the case that you do honestly have to be better than or as a minimum equal to, but truly better than to be seen as equal, unfortunately. I've seen that for myself. So there's just systematic bias on all kinds of levels. Therefore I do help her.

Bridget was supported by the university in her efforts, which had a diversity initiative in effect. She lauded the administration for attempting to change things at the school.

Conclusion

In this chapter, I focused on the relationships formed between graduate students and the relationships formed between my respondents and their advisors. I also explored the types of gender bias women geoscientists' perceived in graduate school. Finally, I examined one woman's mission to improve opportunities for her fellow female graduate students in response to her recognition that "we have to beat the boy's at their own game."

For the most part, women in my study did not report feeling isolated or unsupported in their department. As Fox's (2001) research suggests, the percentage of women in a science department can make a significant difference in terms of women's' immediate perceptions of their graduate school experiences in the sciences. There were even enough women in graduate departments that female graduate students, like Cindy, were able to form all-women support networks.

However, while white women had more opportunities to form relationships with each other, minority women still had the potential to feel isolation and stigmatization as "tokens" in their departments. Ligia, who was non-white, a woman, and an international student, experienced the intersection of these three traits as disadvantage (Collins 2000). Indeed, studies of African American women in graduate school demonstrate that minority women often face challenges unique from white women and may feel excluded because of their race, more so than their gender (Beoku-Butts 2004, Schwartz et al. 2004).

While the women I interviewed felt that they were not discriminated against by male graduate students, evidence suggested that some young men continue to engage in the same processes used to otherize women and devalue their achievements noted historically and in departments/fields where women are in the statistical minority. While some students felt they were in a post-gender society, and that women and men received equal opportunities in graduate school, other interviews pointed to the fact that despite the many gains made by women in the geosciences, they still faced gender inequality. In one department, the same types of protective barriers that have stunted women's ability to work in the field under the same conditions as men for centuries still acted to bar the level of women's achievement.

Evidence from the interviews suggested that elite graduate programs benefit from, and seek to create, "disembodied students," with no requirements outside the ivy tower. In one extreme, students at Southwestern University who took jobs outside the department were threatened with being kicked out of the program (thus, they were essentially requiring people to take out loans, to support anything but the most meager single lifestyle, excluding, one can imagine, single parents or others from seeking graduate degrees in their department).

While all students were expected to focus their efforts on classwork, conducting research, and publishing their results, over and above anything else, these expectations unequally impact women. While men, at least those whom stay within the traditional box of the benevolent but absent husband and father, suffer few consequences for getting married or having children, women who express desire in doing the same may be treated as less-serious and dedicated students, whom no longer deserve the support and time of advisors or the departments more generally. This doesn't mean that women don't want or won't try to "have it all" (marriage, children, and a graduate degree). However, as I examine in Chapter 5, these women often recognize that they must make concessions to do so and will face significant hurdles in their careers if they attempt to balance children with work.

In many ways, female graduate students who want or have children are more vulnerable than women in the workplace. Their academic fate ultimately lies within a few people's hands. To some extent, tenure makes professors relatively immune to accusations of unfairness or discrimination. Ironically, the very structure instituted to give professors the freedom to express ideas and research that might be contradictory to the accepted status quo, has likely enabled many whom engage in even overt acts of gender discrimination and harassment to remain safely ensconced in their position. At my own undergraduate institution, I remember being told to avoid several professors because they still believed—20 years after the fact—that female students should not have been admitted to the school, and made women in their classes feel unwelcome and unwanted.

Proving gender or family responsibilities discrimination (J.C. Williams 2006) as a graduate student is difficult. More so than the workplace, the tools used to assess graduate students are vague and may be unknown to the students themselves (Rios 2010;

Austin 2002). The level of feedback built into graduate school for students is low, and only comes after significant investments in time and effort in their graduate careers (master's thesis, comprehensive exams (if applicable), proposal defense, dissertation defense). Thus, there is little room for students to protect themselves from claims that they just aren't good enough to make it through the program. Alleging gender discrimination could certainly lead to problems gaining employment in the field, especially if a complaint was made against a highly regarded member of the field and/or if other faculty members in the department withdrew support from that student.

Although many students seemed to think things would get better for women in the field once "the old guys" were replaced by "young vibrant scientists," this view ignores how gender bias is structured into organizations (Acker 1990). As the number of applications to graduate school increase, the competiveness among graduate students to gain entry into graduate programs and seek increasingly limited funding opportunities will also increase. As more students begin to see master's degrees or PhDs as necessary to the type of jobs they want access to and the type of lifestyle they want to pursue, (rather than needed for a competitive edge, or a continuation of working in a field they love) the level of stress and self-induced pressure placed on students will only continue to rise. This is the perfect petri dish for a high-level of exploitation of graduate students, and creates opportune conditions for engaging in gender and family responsibilities discrimination. When competition is high, there is more room to scold students for not being "fully dedicated" to the field.

Chapter 5. Plans for life after graduate school

In this chapter, I explore students' attitudes toward and perceptions of the career options available to geoscientists. I am both interested in how these perceptions are formed, and how students weigh the various considerations that go into selecting a career path. I analyze how perceptions of gender bias may impact women graduate students in the geosciences' career choices.

Where do geoscientists work?

Geoscientists work in a variety of jobs and settings, though the options available to them are dependent on the level of degree earned. A study of recent geoscience master's graduates found that 24 percent were working at an academic institution, 22 percent were working in government, 21 percent were working in the oil & gas industry, 20 percent were working in the environmental industry, and the rest were working in "other industry" or non-profit research institutes or were self-employed (Gonzales, Keane, & Martinez 2009). By comparison, 67 percent of PhDs were working at an academic institution, 18 percent of PhDs were employed in government, 3 percent worked in the oil & gas industry, and the rest worked in the environmental industry, other industry, a non-profit research institute, or were self-employed (Gonzales, Keane, & Martinez 2009).

Given the prevalence of academic jobs and jobs in the oil & gas industry for geoscientists, it is not surprising that many students expressed a preference for entering one sector or the other, or both. Perceptions of these careers will be the focus of this chapter. Five students were *not* considering academia (at least immediately prior to graduation) and/or the oil & gas industry, as their primary career preference. These students' opinions are included throughout, as applicable.

How students learn about careers

Students had formal and informal opportunities to learn about careers in the geosciences. Most formal opportunities tended to be weighted heavily towards the oil &

gas industry; as I will explore later, oil & gas recruiters were frequent visitors to three out of the four campuses. While on campus, they would hold informational events, conduct interviews, and network with students. Students who were able to get highly sought after internships in the oil & gas industry got an introduction to the work they'd be doing as professional geoscientists, and further, created relationships that might help them get hired in the industry further down the line. In fact, some companies would only hire young geoscientists that had prior internship experience with them. The American Association for Petroleum Geologists, Society for Petroleum Engineers, Geological Society of America, and other professional organizations provided multiple opportunities for students to attend conferences, where they could network and interview with recruiters, and sent newsletters on job opportunities appropriate to geoscientists. In some cases, student chapters of these and other organizations planned short courses and brought in outside speakers to their departments. University-wide career fairs were generally considered unhelpful, given the specific type of work geoscientists do. However, one student praised the university career center for bringing many relevant companies to campus during their bi-annual student career fairs. Other, less formal, exposure to careers came through networking at conferences and talking to speakers brought in by the department to share their research. The final way students learned about careers was through analyzing their advisors' lifestyles. In fact, it was their observation of their advisors' lifestyles that turned many students off pursuing an academic career, or at the very least, an academic career focused on research.

Thoughts on academia

Many geoscientists find employment in academia. In 2009, there were over ten thousand geoscientists holding faculty or research positions at 4-year universities and colleges (Gonzales & Keane 2011). However, the market for tenure-track academic positions is relatively small and smaller than in the past. In response to the 1980s oil market crash, fewer people sought training in the geosciences during the 1990s. As a result, when faculty members retired, they were typically not replaced. In addition,

because of the recent economic crisis, and its effect on retirement accounts, professors are holding on to their jobs longer (Gonzales & Keane 2011).

According to a survey of conducted by the American Geological Institute, sixty-one percent of graduate students hold a positive attitude towards a career in academia (Gonzales, Keane & Martinez 2009). Not surprisingly, PhD-level geoscientists are more likely to hold a favorable opinion of a career in academia than master's-level geoscientists (81 percent vs. 45 percent) (Gonzales, Keane & Martinez 2009). Six students in my sample expressed at least some interest in conducting an academic job search upon graduating from their programs. Another three students expressed interest in seeking a professorship later in their careers. Students who expressed interest in working in academia liked teaching and researching, though the extent to which they privileged one over the other varied. Many of these respondents worked in areas of the geosciences that were not as valued by the oil & gas or mining industry, though some of these respondents had gained knowledge and skills that could easily be leveraged to serve industry's needs.

Perceptions of teaching versus research careers

Within academia there are two general categories of jobs: those oriented toward teaching undergraduates (for example, faculty positions at a liberal arts college or teaching university) and those more oriented toward research (for example, a research position at a university or a faculty position at a research university). Graduate students who find faculty or research positions at a research institution typically come from a high-ranked program, have research experience under a high profile mentor, and have authored numerous refereed publications, as well as made well-received presentations on their work at professional conventions. Although jobs at some highly-ranked teaching institutions and liberal arts colleges are also very competitive, departments at these universities tend to pay more attention to applicants' teaching experience (number of courses taught, number of different courses prepped), teaching evaluations, letters of recommendation from former students, and other tools to get a better sense the teaching and mentoring abilities of the applicant.

The working conditions at a research university versus a teaching college are, by definition, very different. Academics working at a research university typically have lighter teaching loads, more funding and other resources available to assist in research (e.g., labs, graduate students, equipment, grant writers), and more access to other researchers. They are expected to win grants to support their research, as well as fund and mentor graduate students in the department, and to publish frequently. Academics working at teaching colleges have high course loads, are expected to advise and mentor undergraduates (as opposed to, for example, directing students to a separate department that specializes in helping students in these areas), and are typically expected to participate in service to the university/college and department. Academics working at teaching colleges have more time to work with students, but less time or resources for conducting research. Students noted and commented on the distinctions between a teaching and a research-oriented career.

In my sample, only one student expressed interest in working at a research university. In general, he wanted a job that provided him a stable salary and allowed him to conduct work on his own research interests. He recognized that university jobs were difficult to come by, and was open to positions in a research lab at an oil & gas company or elsewhere if his plans to be an academic fell through.

Other students were interested in finding employment at a teaching-oriented college after completing their graduate programs, or later down the line in their careers. Many of these students emphasized their interest in working with and mentoring students.

For example, Daniel spoke of his experience teaching at several community colleges and working at a museum in explaining why a job at a teaching university would be more in-line with his interests and needs than a tenure-track position at a research university. Due to constraints on his job search (he needed to find a place where his wife, a dentist, could teach as well), Daniel was not precluding a search for research-oriented positions. He did not, however, feel it would be the best fit.

Kevin also emphasized how much he enjoyed working with students. In fact, Kevin had used part of his grant money to create a semester-long class for undergraduates in the geosciences at his university. Feeling that the department did not do enough to expose undergraduates to careers in the field, he created a class that would introduce

them to available jobs in the geosciences. In deciding that teaching institutions would be a better fit for them, Kevin and Daniel were implicitly acknowledging that a research-oriented position was not amenable to these interests and skills, and in fact, might even disincentive them from community outreach, mentoring students, and allocating time to their teaching and advising capacities.

Respondents described academics at research institutions as harried: They traveled a lot, worked long hours to publish the requisite number of papers needed to earn tenure and/or maintain visibility in the field, and struggled to maintain a good balance of work and family time. These portraits of academic researchers were not drawn out of thin air; rather, respondents drew on their personal contacts with academic researchers to draw their conclusions. (Similar perceptions held by graduate students of their advisors were noted in Austin (2002)).

Kevin looked to his undergraduate and graduate advisors as exemplars of academic researchers. Kevin remarked that although his advisor owns a house, he probably spends more time traveling than at home. According to Kevin, his undergraduate advisor had worked 80 hours a week and spent much of his time travelling as well. Kevin was under the impression that both of his advisors enjoyed their jobs and didn't mind their lifestyles. However, in watching them, he had drawn the conclusion that he, personally, "wouldn't be happy doing that." He did not believe this lifestyle was ideal for finding a spouse or being a father.

In fact, according to Kevin, it was the academic lifestyle more generally that had been the cause of the dissolution of his previous relationship. Although he had attempted to maintain a long-distance relationship with another geoscientist he had met during the master's program, the fruitlessness of his efforts became clear when he realized it would be year*s*, if ever, until they managed to live in the same place again.

While he was willing to sacrifice to be an academic, at a certain point, he drew the line. He was not willing to put in the time and effort that his advisors did into developing their careers. He recognized that this would be necessary to succeed in a research position:

> At an R1 university, [my advisors' lifestyles seem] to be what's expected in order to do a good job and feel successful. So I'd like to be in a situation where there wasn't that much pressure in order to feel successful.

Kevin was choosing to opt out of a research position.

When I interviewed Milton, he had not determined whether he wanted to work in the oil & gas industry, the U.S. Geological Survey, or whether he wanted to be an academic. However, he had already decided that if he stayed in academia, he would take a faculty position at a teaching university or liberal arts college. He couldn't "see" himself "writing proposals left and right and managing ten graduate students" or otherwise "living the academic life." Although as a graduate student he traveled a lot to the field and to academic conferences and meetings, once he graduated, he wanted to find a job in which he would be free to arrange his work, field, and conference schedules to "jive" with his family's schedule.

> My ideal sort of lifestyle would be one where I can continue to do well professionally and academically, whether I pursue an academic profession or a non-academic profession, but at the same time maintain a balanced home life with my soon-to-be wife and my future kids… A balanced lifestyle, that's what I, that's sort of the ideal lifestyle for me: a balance between the professional side of things and the personal, family side, side of things.

Not yet on the market, Milton was trying to figure out what career would allow him to maintain a work-family balance.

Daniel also mentioned the ability to maintain work-family balance as important in selecting a career path. In fact, even though he was several years from graduating, he had already sought advice on finding this balance. When outsiders came to speak to graduate students in his department, Daniel would approach them to ask if their jobs allowed them to make time for their families and about the strategies they had for being successful as workers, spouses, and parents. According to Daniel, people were "surprisingly open" about the issues they faced in maintaining a family life and career. Over time, Daniel began to identify a trend among those who seemed the most content with their ability to balance work with family: They were not research academics.

> Most of the people that can really balance, have a very healthy extracurricular life—things outside of their research and teaching—seem to be at the smaller institutions where they get to teach and really engage with students, but not be harassed the whole time to publish a great volume of research and get the big money grants. They have a little more freedom to do the things that they like, and oftentimes their research

> dovetails with their personal interests, which works for me quite well because the areas where I do research happen to be the areas I love to go backpacking and hiking and all that stuff, as does my fiancée.

What is surprising is that these are the types of things that researchers typically hear from women. In this case, many men also seemed keen on following career tracks that would allow them to balance work and family in a way that enabled them to feel like successful fathers, husbands, and workers.

Some students reported feeling pressure to pursue a career trajectory that would result in securing a research position at an R1 university, that is, a university that focuses on the production of research, or a research position at another "prestigious" institution. Recognizing that their departments wanted them to pursue an R1 job did not deter students from seeking their own career paths (whether it was aimed toward a teaching or industry position). Rather, what it did do is force them into secrecy regarding their career plans. The end result is that students could not seek the support they wanted or needed in regards to career planning. It also caused students to worry that their secret career plans might be exposed, and in some cases, affect their eligibility to hold teaching assistant or research assistant positions or to receive other types of funding. All students in this situation felt that if professors in their departments learned of their plans, at the very least, they would cut back on effort expended on them.

The pressure to go into academia was especially high at Southwestern University, where all three of my respondents reported experiencing it. Milton was clear that his own advisor was very supportive of his students' goals and gave concrete examples in which his advisor had gone out of his way for a student or shown flexibility. However, the department as a whole, according to Milton, was not supportive of students who did not plan on going into a research position:

> They [the department] tend to push their students to the prestigious big-name academic schools, whether its post-doc positions or whether it's professorship positions, or NASA, or maybe USGS, or even the larger sort of government prestigious government agencies or labs or whatever. They have a different take on things. I feel sometimes that I can't express my intentions to them, because I feel like if I do it may affect whatever TA or RAship awards that they have set out. It's unfortunate because I feel like I'm not being very honest with them. I hate not being honest with people. But unfortunately that's sometimes how things work here. If you make

> your intentions clear from day one or whenever during your career here that that you don't want to pursue an academic position or you want to pursue a position in a private company or something that's not academic, then I feel like they don't… they're not very supportive of you during the degree and beyond.

Milton thought that professors at Southwestern viewed students who pursued jobs in the industry as "lost causes": "'Oh look, it's such a shame that this talented person is wasting their time in some dead-end cubicle job,' as opposed to becoming the next Nobel Prize winner."

Rita agreed with Milton that the department's goal was to place as many students in R1 institutions as possible. Rita had worked at USGS before returning to graduate school and would like to return there after she earns her PhD. When she shared those plans with her committee, they discouraged her from pursuing them:

> And during my orals for my comprehensive exams, they sit you down at the end, the people on your committee and say, so what are your long-term goals? We want to help you toward your goal and so we want to know what it is that you're interested in doing so that we can do that". And I told them that I was interested in working, again, for the USGS and that didn't go over real well. There was a lot of headshaking and sort of the idea that I was…they said it perfectly explicitly that I was, I would be, wasting my…my talent. That I really shouldn't this early in the process limit myself to that, that I should also think about research or teaching at a university.

Although Rita was not concerned that resources would be pulled from her now that she had expressed her career intentions, she also rarely talked about them openly.

Another student did not attend Southwestern University, but like the other three respondents he felt pressure to pursue a job at an R1 institution. According to him, his advisor and his department were "grooming" him and other students for an R1 job: "They want their students to be the best of the best type of a deal."

Several weeks before our interview, this student had met with his advisor. Spontaneously, his advisor acknowledged that given his interest in working with students and his mentorship and teaching abilities, he would be a good fit at a teaching-oriented university or college. After several years of working together this student, felt, for the first time, his advisor was finally starting to understand who he was, and what he wanted: "My advisor, finally, I think, just this semester, is getting who I am." His advisor joked

that he would be okay with the student working with undergraduates, as long as he "sent him" his students for graduate school. The student felt a huge weight lifted off him when his advisor showed his plans these new signs of acceptance. However, he still felt that it was better to keep his plans under wraps:

> It just made me finally feel like I could relax a little, because I definitely have that as a… It was a concern, and it is a concern of mine. I don't, like I said, I don't advertise that to the rest of the department.

The student didn't feel that the department would take away his funding if they found out his career intentions. He did think professors might withdraw from working with him, preferring to spend their time with students who would make a better name for them and the university. Currently, he has a great rapport with potential collaborators in the department; however, he "could see the potential" of losing it if it became known that he was not seeking an R1 position.

Women and academia

While the male respondents cited above viewed the academic researcher's lifestyle as incompatible with having fulfilling lives as fathers, husbands, and individuals outside of work, Rita's critique went further: She saw academia as incompatible with women's lives. Although she had looked for women role models in academia who had managed to have children and a successful career, she had found very few.

> In academia, in terms of female role models that are successfully balancing career and family, I know of two women out of maybe 50 and I know probably 10 women that have left geology entirely because of the difficulty they had and the lack of support that they had when they did have children.

Rita went on to explain exactly why an academic's workload did not mesh with motherhood, listing the tasks a professor was responsible for: "With professors you have all the students you have to deal with, you have to be writing proposals. You have to be doing your own research, you have a teaching load…"

Rita recalled a male professor asking her why "there are so many beautiful, smart, young women graduate students but there are no women professors." Moving

beyond the sexism that shapes the above comment (the professor placed equal emphasis on women's intelligence and looks in referring to his female graduate students), we can see how this comment also demonstrates the way male privilege operates. While it was unapparent to Rita's professor why women might leave the geosciences, the reasons were readily apparent to Rita. Rita recognized the importance of her professor's wife, who stayed home with the couple's four kids, in enabling her professor to have children and still continue to take expeditions into the field.

According to Rita, men were able to balance work and family because they "have different expectations." Whether Rita was referring to men's individual expectations of what it meant to be a husband and father, or society's expectations of men's role in these functions, she points to a historical difference in the time and effort spent engaging in care- and housework, in which women are more likely to carry the heavier load (Hochschild & Manchung 1990; Schiebinger & Gilmartin 2010).

Rita saw the USGS as very compatible with having children. In the office where she had worked, women scientists outnumbered men. Those with children seemed to balance their care work easily with their paid work. Some USGS offices have daycares attached, to make this balance easier. Rita also liked that the researchers at USGS hadn't compromised on the type of work they do in order to find a job that enabled them to also be parents: "They were still doing world-class research, that was the thing. The expectations were just more reasonable, and I feel like they had more resources for supporting the possibility of being a mother and a scientist." Rita points to the fact that organizational context matters for women to succeed (Fox 2001; Rosser 1999). When the job is defined such that workers are expected to have a life and responsibilities outside work (the daycare, flexible working schedule), women are more likely to succeed.

Academia and the dual-career couple

Another drawback to academia was the belief that it was harder for dual-career couples. Kevin had experienced how difficult it was to maintain a relationship with another academic. When his partner moved across the country to obtain her PhD at another program, they had tried to keep the relationship going. However, they began to

realize that even once they graduated from their respective programs, there would be post-docs, multiple assistant professorships and lecturer positions, until they finally landed permanent jobs. All this moving, they believed, would make maintaining a good strong relationship difficult, and having children, if they so decided, tough.

Annie was put-off from academia because of her suspicion that it would not enable both her and her fiancé to have successful careers. Noting that the academic job market was extremely tight, she doubted that she or her future husband would be able to negotiate for a spousal hire, that is, if one of them was even able to find an academic job. She and her fiancé were not willing to split a single position. Annie noted the unfairness of this job arrangement from the employees' perspective: "Great for [the university], but they're basically getting twice the work for one salary." Lately, she and her fiancé had been considering industry instead: "I have people that I talk to both in industry and academia and everyone (laughs) always says, 'Well, Houston is an easy place for two career geologists.'"

Work?

Several students indicated that they preferred going to "work" to remaining in academia. For example, Bridget, a student at Western University, said she wanted to leave the teaching environment when she graduated from her PhD program: "I have already benefited from going to work before I did my PhD, and I want to essentially go to work, if you like, before I make the decision about teaching or not teaching." Similarly, Milton, although he corrected himself, referred to industry jobs as "real jobs," in comparison to academic jobs.

> The answer to this question will depend on the day you ask me, because sometimes I'm totally psyched about academia. I'm like, "Yes. I want to do this. This is exactly what I want to do," and other times I'm like I just can't wait to get done and get a real job. And when I say real job, I'm putting quotation marks around real job, because that doesn't mean that professors don't have real jobs.

In another part of the interview, Milton talked about how the department pushed undergraduates into graduate school instead of "quote unquote real jobs." The application

of "work" to non-teaching/research jobs reveals that in some respects, the job of professor is conceptualized as "not work." Surely the students don't think that their professors don't work hard: Their perceptions of their advisors' lives and their reluctance to take on their long hours demonstrate this. But staying in academia is a continuation of their current trajectory. Many of the students already teach undergraduate courses, lead field trips, or act as teaching assistants. To be a professor is largely a continuation of the activities they already do.

Also, many of the students see their professors' passion for their research and teaching. Thus, what the professors do doesn't seem like work. Work is often dichotomized against "free time, "fun, and the "private sphere." Because professors presumably would read and write about the same topic material, regardless of whether they were paid for it, their job doesn't look like "work." This theme was also evident in the fact that several respondents saw academia as something they could retire into.

Funding

The base salary of an academic may turn-off some geoscientists. For those whose area of expertise permits them to work in areas outside of academia, the low pay of academia compared to industry geoscientists may serve as impetus to take an industry job. According to AGI, in 2006, post-docs made an average starting salary of $43,100 and $42,000 median starting salary (Gonzales, Keane, & Martinez 2009 3.9). Academic geoscientists in tenure-track positions made an average starting salary of $51,900 and a $52,500 median starting salary (Gonzales, Keane, & Martinez 2009 3.9). By comparison, a master's level geoscientist will make roughly double an entry-level academic if he/she takes a job in the oil & gas industry (calculated utilizing statistics from Gonzales, Keane, & Martinez 2009).

Another downside to academia cited by many was the pressure to write grants to fund research and felt as necessary to pad the relatively low base salary of a career academic. By comparison, there was no need to seek "soft money" in industry. Milton cited the lack of a "stable salary" as a drawback of working as an academic:

> If we were in an ideal world, my ideal lifestyle would be to have a more stable source of income, as opposed to having to write proposals to get what we call "soft-money" to complement the hard money, the base salary that professors make. I want to have a more stable income. It doesn't matter if it's a gazillion dollars or whatever it is as a type of income, as long as it's stable.

Several students said that their experiences trying to fund their own research and/or education through grants had turned them off from relying on this type of income in the future. Grant writing was time-consuming, risky in terms of rewards, and resulted in high-levels of oversight. Said Annie, "I don't want to write grants for my career that have a 30 percent funding rate."

Meanwhile, industry recruiters at events I attended boasted about the level of pay in the industry, mentioning things like, "This is the highest paying industry." One recruiter talked about opening her first paycheck as an intern and being flabbergasted by the amount written on it. She discovered that was only the first month's pay, she reported to the audience members with bubbly enthusiasm. Another recruiter, in mock advice-giving mode, told students "Don't go and buy a BMW when you get your paycheck." While on the grand scale, entry-level academics make a good wage, in comparison to what they could make in industry, the academic wage likely appeared paltry.

Slow-paced

While one of the benefits of working as a career academic was the freedom to research topics of interest, Rita viewed academia as stifling. To her, industry's fast-paced environment meant that workers were exposed to numerous shorter-term projects, allowing them to gain expertise and experience working in multiple areas over a short period of time. By comparison, academia could be slow-paced and stale:

> I know that especially on some academic studies you can be working on a project which could be renewed and you might be working on something consistently for like 10 years or 15 years in some cases which is dependent on the availability of resources, but at the same time we all like a change now and then.

Thoughts on Oil & Gas Industry

In a study of graduates, AGI found that 35 percent of graduate students (42 percent MA/MS vs. 27 percent PhD) had a favorable attitude toward students pursuing careers in the petroleum industry, while 67 percent of advisors were positive about it (Gonzales, Keane, & Martinez 2011). Five of the students in my study were considering a career in the oil & gas industry, three women and two men. In general, students who were interested in the oil & gas industry saw it as everything academia wasn't. Academia was slow-paced, industry wasn't. Academia meant grant writing, industry didn't. Academia was bad for dual-career geoscientists; Houston wasn't so bad.

However, at three of the schools (all but Southwestern) many of the students interacted with the oil & gas industry in one way or another. The oil & gas industry used aggressive tactics to recruit potentials workers. I cover these methods here.

On-site recruitment

Three out of four departments hosted recruiters from oil & gas companies on-site. Although there are slight variations in how recruitment is organized from campus to campus, the recruitment process is fairly similar no matter the department. In early fall, the department advertises which companies are recruiting and the dates each companies' representatives will be on campus. Students interested in interviewing with a company submit their resumes either to the department, or directly to the company, by a predetermined deadline. If the companies are interested in hiring a student for a job or internship, they schedule an interview with him/her during the time the recruiters will be on campus. In addition to interviewing students on campus, recruiters typically hold an information session to share information with students about the company. The oil & gas recruiters engage in multi-pronged strategies to win students over: these include paying for meals, maintaining long-term contacts with students, and identifying with students' concerns.

Wining and dining

It is typical, in fact, expected, that recruiters will provide students with lunch or dinner at the information sessions. Some recruiters go above and beyond, taking the students off campus for lunch or dinner. According to Julia, a student at State, the recruiters typically take them to what are largely understood to be the "nicer" restaurants in town. In fact, one large independent takes State students to *the* nicest restaurant in town. While providing students dinner probably doesn't impact students' decision to go into the oil & gas industry, or which company to work for, it does allow companies to set themselves apart from each other. After all, Julia remembers who took her out to dinner and where.

Providing students with meals has other benefits to the company. One, it allows the recruiters a chance to promote the company in a more laid-back, "authentic" setting. While information sessions consist of PowerPoint slides, the informality surrounding sharing a meal, allows students to "get to know" the recruiter, and probably, to feel that they are getting the real scoop about the company.

Providing students with meals also gives recruiters a chance to screen potential interns or employees. While the interview setting allows recruiters to get a sense of the students' experiences and interests, the less formalized setting of a restaurant lets the recruiter see how the student acts in more typical settings, to test, for example his or her social skills. So popular was this method of getting to know graduate students, Rita remembers going out to lunch or dinner at least once a week with an oil & gas representative during her master's program.

For a relatively small output, the oil and gas companies can make students feel special, as if they, too, are in the big leagues. Cindy had interned at a small oil company in the Midwest. The company had everything she was looking for: it was small, it was stable, and it was *not* in Houston. The company kept in contact with her, which was a good sign they would make her a job offer when she graduates. Recently, though, she received an internship offer from another company, which was likely to lead to a job opportunity. The company flew her down for an interview and wined and dined her. Half jokingly, she told me that she was now rethinking her future career plans: "They flew me

down, picked me up in a limo, took me out to steak dinner. So I can't say no."

Funding

Oil and gas companies occasionally offered students unsolicited funding. Part of Ryan's research was funded by a major, even though, "nothing that I really do is directly related to oil or anything an oil company does." Ryan's only condition for receiving the money was to write a thank-you note to a representative from the gifting company. Heather was also fully funded to attend Midwestern University by one of the majors. The requirement for accepting was that she apply to the company's internship program. Heather wasn't remotely interested in working for the industry: Her research was on volcanoes.

However, while receiving industry funding had not swayed Heather's opinion on the industry, sometimes it was successful in doing so. Annie had decided to interview with the oil & gas companies to get a sense of what industry was like, even though, at the time, she was interested in remaining in academia once she graduated with her PhD. She knew in advance she couldn't take an internship because of a previous research engagement, something she was forthright about with the companies. She received three internship offers, anyway. Even though she turned down Company X's internship offer, she was invited to attend a short course they were giving, which Company X paid for, as well as her round-trip plane ticket. In addition, Annie was given $6,000 to support her master's thesis. According to Annie, "that kind of made me think a little more intensely about industry and the opportunities there."

Staying in touch

The relationships developed at conferences, interviews, and internships between students and recruiters were often long lasting. For example, the Midwestern company that Cindy interviewed for checked-in regularly, to see, for example, how close she was to graduation.

Annie had done two internships and had a third one planned for the next summer.

Throughout her tenure at Midwestern University, she had gained a lot of experience interviewing. She had also helped set up many of the recruiting visits, meaning she had the benefit of lots of informal face time with recruiters from different companies. I asked her if she had trouble balancing her relationships with multiple companies: Were the other companies upset when she opted to take an internship at another place? Annie replied that she was simply honest: She told the companies that she hadn't decided what she was looking for in her career and that her goal was to keep trying on as many places as she could for fit. Annie felt that she had developed real relationships with the recruiters, and that she could be honest with them about her intentions: "You know, I've known these people for like *six* years now, so I kind of feel it's kind of beyond the recruiter relationship, almost being like a friendship."

Addressing common concerns

The recruiters are also skilled at allaying students' common concerns about working in the industry. Ryan's favorite interview was "free form, more of a conversation" with a recruiter from Company Y. The recruiter asked Ryan his perception of the public's attitudes toward the oil and gas industry. The recruiter then shared his own changing opinions toward the industry.

> The guy, he was talking to me about his environmental views when he came out of grad school, and he was saying that he actually had pretty radical environmental views. Sort of…I don't know if he was anti-oil, but sort of along that vein, sort of very radical views. And basically he said he took an internship at Company Y and learned more about the science that goes on there and sort of decided he could be radical and outspoken against the oil industries or sort of try to change the company from within. The change is a hard thing to come about. We talked about this, too. It's basically going to take a whole army of people that want to do good. And that may actually never happen. But he can try to make it happen from his individual standpoint.

Ryan was considering going into the environmental industry, so the oil & gas recruiter was able to connect with him on a key concern.

From my ethnographic field notes, I found that it was common for industry recruiters to engage in this type of publicity work. Pictures at one event I attended were specifically chosen to showcase diversity within the particular oil & gas company advertising itself: Half the group was women, and the other half was men, and people of all colors were incorporated. The recruiters, rather than being white men, were two younger women, one black and one white.

At the same event, the recruiters talked about their commitment to the communities serve.

> She also spoke about how Company M tries to make everywhere they go "better." So they volunteer a lot. If they extract something from an area, then they make it "better." This came up again later, but no one asked questions on it. (Fieldnotes).

The recruiters, who were making their presentation only several months after the oil spill in the Gulf of Mexico, actually addressed potential concerns about the latter in a subtle way:

> First they shared the motto of Company M: [redacted]. Safety was extremely important and you couldn't go anywhere at Company M without thinking about it. There was always a "safety minute" going on or something like that. Integrity was important and you'll never see Company M in the news for doing something it shouldn't have. (Fieldnotes)

Pressure to help maintain ties with the oil & gas students

Some students felt pressured by their departments to interview with the oil & gas companies, to help maintain the strong tie between industry and the department. Rita currently attends SW University (which has no industry ties), but for her master's she attended a large university in the Midwest:

> There were a lot of a lot of feelings from the school that we got a lot of oil money, a lot of our research or a lot of the things that we had the University for the program had come from the oil industry and so we needed to at least have polite discourse with the oil guys when they were there. Go to their talks and go out to lunch with them. So I don't know that there was really the expectation that we go into oil but we were at least strongly asked to consider attending functions at which they were providing goods and services.

Several students spoke of the large amount of money Midwestern University received from the oil & gas industry. According to Ryan, students were expected to at least interview with the company: "It's the type of thing where they kind of scratch our backs, and we're sort of expected to scratch theirs by interviewing." Evan said that students at Midwestern are "encouraged to interview with the companies. Basically *told* to interview with the companies."

Internships

For some, internship experiences helped point of areas of weakness that students needed to improve on in order to be offered a job in the oil & gas industry. Julia did a summer internship with Company Y. At the end, she didn't receive a job offer. Her internship mentor said it was because she didn't have enough sed strat experience, and her thesis wasn't closely aligned enough with the oil company's needs. Julia couldn't change her thesis but had signed up for more sed strat courses and started working toward a petroleum certificate.

Internships helped provide students with insight into company environments. Julia, for example, felt that the employees at Company Y seemed "friendly and happy." On coffee breaks, she would go sit in the main lobby to people watch: "Everyone filtering into the building was smiling and seemed genuinely happy to be going to work. And I think that's a great thing in a company, if people actually want to be there."

Julia didn't feel that the internship lived up to the recruiters' claims that "we give our interns real projects that lead to real decisions that we need to make," a claim I heard numerous times during my ethnographic site visits to oil & gas recruitment events. Although the project was interesting, at times Julia felt like she was doing "busy work" to satisfy her mentor's interest. Her friends with internships, she thought, had better overall work experiences. But even if her project didn't up changing the way Company Y operated, she felt she had learned a lot, gotten the chance to meet and interact with a lot of people, and also, she appreciated the opportunity to travel to a weeklong conference with her mentor.

Annie had already completed two internships when I interviewed her and had a third one planned the following summer. She had chosen her internship opportunities strategically, opting to intern only with companies for which she was interested in working. She knew that interning for a company would give her an edge at getting a full-time job, and some companies would not hire students who had not interned for them in the past. In addition, interning for companies helped Annie get a feel how it might be to work there, not only as a geoscientist but a woman geoscientist.

Environmentalism

Some students' sense of environmentalism put them in an adverse relationship to the oil & gas industry. Ligia had feared coming to a school where oil & gas "pays for everything in the university"; however, in the end, her research interests were so different from the needs of industry that she never felt pressure to interview.

Rita, who had gone to an oily school before switching programs, had strong views about the oil & gas industry, at one point referring to it as the "enemy." When I asked her to explain, she clarified:

> Well, and I think this is the case with a lot of, at least people that I know, we have very strong environmental and political views and very strong feelings about the way that we're using our resources, and we don't want to be a part of the whole national gas thing and, if we're going to contribute in some way, we would rather contribute our time and skills and intellect to finding better ways of using better energy sources and clean energy.

Kevin was a pragmatist. According to Kevin, oil was necessary "for the way we operate our society right now." But as a self-identified idealist and liberal, like Rita, he didn't want to be part of its procurement.

Ryan had considered the oil & gas industry, but had been leaning toward environmental consulting. However, he didn't see a huge moral divide between working in either: "I don't think if you're interested in the environment, you should exclude yourself from thinking about oil as well. But certainly, there are environmental concerns." While Ryan considered himself to be concerned about the environment, he didn't see really any way to make a difference.

> It's funny because actually everyone talks about how you sell your soul to oil companies and "blah, blah, blah," but I've heard worse things about the consulting field, actually. It's sort of more soul-crushing in the consulting field, because if you're really out there to make a difference, and like clean up the world, a lot of what you do in consulting is just sort of covering people's asses—pardon my French—but it's like you, you just kind of keep people meeting government regulations. The minimum that they have to do to meet regulations is sort of what you do and monitoring to make sure they're meeting some minimum requirement. It can be quite discouraging if you go into it thinking that you are going to change the world, but I still think that you can approach the job in an ethical way with that knowledge. So it's not something that I expect to find some deep fulfillment in life through.

Other students reconciled their interest in the environment with their future career plans. Ron cited his love of the earth as sprouting out of his interest in geology. However, the world still needed fossil fuels to run.

> People ask me "What are you going to do when everything is run on electricity and solar cars." And I'm just like "Well, you still need oil to make plastics. You still need natural gas." That's one thing that being a geologist has given me, is a real appreciation for the earth. I think that we should really take care of the Earth and limit our consumption of fossil fuels and conserve energy and things like that. But I mean, it's a necessity, and I don't think it will ever really go away.

Cindy made a similar statement about how oil would be needed to produce plastic even if the world managed to cut down on its use of fossil fuels for driving and other purposes. A member of the Green party, and active environmentalist, Cindy explained how her career in the oil & gas industry could align with her "liberal" politics:

> My sister who lives in San Diego already tells me I sold my soul to the oil industry, etcetera, but my answer is "change comes from within." And you get the newer, younger people with different ideas debating the corporate good old boy business conservative values and it changes. And even at [the service company at which she had worked], and I knew tons of people who are liberal, who recycled, etcetera, etcetera.

In this excerpt, Cindy forgot about the fact that her own liberal politics had singled out to receive hate mail after 9/11 from her coworkers.

In addition to adding young people to the industry, Cindy felt that the BP disaster would go a long way in improving industry practices and forcing it to be more environmentally friendly:

> Things are already shifting. I really think that within 10 years… I mean, the BP disaster, I think was actually good because it made America look, and it made businesses have to be environmental, and act like "oh my God. This is horrible! We have to prevent this from ever happening again." It was a really good thing to show the world that environmentalism is also protecting the economy, because when something happened like that, we ruined the economy of Louisiana. Look, taking care of the world, is also taking care of ourselves. We're too dependent on everything out there in nature, and pretending that were separate from it is stupid. It is, it's shifting already.

The BP incident was still prominent in people's minds when I interviewed them. One student told me that she would still consider working for BP; she wanted to sift through all the reports before taking all the bad press in blind faith. She felt like the company truly regretted what has happened: "Lives were lost; ecologies were seriously destroyed, and it was a bad thing all around." Having interned at BP, she felt that the company had demonstrated its concern for the environment, providing, for example, recycling bins, even for dining refuse. Another student said that she had always thought highly of BP because prior to the spill, it "was the leader in the energy industry researching alternative energy. They spent the most money and had the most divisions dedicated to other fuel sources beyond petroleum and that really impressed me. I thought that was really smart business, because everyone else has an expiration date on their company right now." Working for a company that took the environment into consideration was important to Julia.

Small acts of environmentalism at a company served as good PR for geologists with an environmentalist bent. Cindy was drawn to the small oil & gas company she interned for because they showed concern for the environment, by putting recycling bins at every person's desk.

Thoughts on companies

Julia wanted to work in a big company, because of the training opportunities available. She also liked that large firms hire in new cohorts of professionals together, so that there would be an opportunity for bonding with young coworkers. However, she had

also heard from others that smaller companies offered more flexibility and had lass "red tape" and "paperwork " than the majors or large independents. Cindy was also drawn to the training opportunities the majors offered, although morally, she was against working for a larger oil & gas company: "I didn't really want to work for Company A or Company B or any of those big, evil corporations, but after seeing all of my friends, and learning about the training that the biggest companies give, I don't want to shortchange myself either."

Ron saw small companies as more versatile and allowing more freedom to workers to be creative. He had spoken to a friend at a major who told him, "Well, you know, I hear we drill oil wells. I don't know, though."

> He's in an office working on one specific thing all day long, every day. I think he does slat tectonic stuff. But that's all he does. He doesn't have any input on actual activity He has no idea what his work is going toward. He's the cog they put in the hole.

He also liked that smaller companies weren't as focused on grades as proven ability in the field. Many majors wouldn't consider hiring him because he had less than a 3.5. However, the small companies were interested in him because of his experience: "That's another thing I like about smaller companies is that they're looking at the actual person, and not just the statistics."

Impressions about companies flowed through graduate student networks. As one student said, "Grad students like to gossip a lot, so anytime someone has an internship, I always ask, 'What was it like? How are the people?'" One company had the impression of being "snobby and sort of anti-social" and teams were known to get very competitive. Another was known for only hiring "pretty girls." One company put off one student because the recruiters were "smarmy." He felt like they gave off a "big man on campus vibe when they're in town." Long-lasting opinions could be formed off the basis of one interview or interaction with a company representative. For instance, one woman refuses to work for a company because of how rude the interviewer was to her. Other companies were popular within a given department.

When will the "old boys" just leave?: Gender and professional geoscientists in the workplace

Although students may not have viewed gender bias as inhibiting women's success in graduate school, many recognized that the workplace might present barriers to women. For example, when I asked Milton if he noticed any problems experienced by women in his department, he answered that he didn't see any "issues as far as inequality is concerned, as far as gender bias is concerned." Then, he clarified:

> But this is coming from *purely an academic environment*. Now if you would ask me the same question about the professional environment, then it's different. It's certainly different in a professional environment.

Milton had three work/internship experiences. The organization for which he had worked last, he considered "progressive." However, at both of the previous companies he had interned for (in hydrology), he had noticed a complete absence of women scientists. In the first company, women only worked in secretarial roles. In the second, there were no women on staff, just a female high school student who interned in the office, largely filing and copying paperwork. Milton concluded: "I don't want to say that…I don't want to make the professional world in the geosciences sound bad because they don't make men work and they make women do the tedious jobs, but that's sort of the general pattern that I've seen." Milton emphasized that both of these companies had been small, and it wasn't likely larger companies were also this segregated.

Milton and Kevin utilized similar language when talking about the potential of women geoscientists facing bias. Just as Milton started with "I don't want to say that…", Kevin started his explanation of how female graduate students were sometimes harassed, "With I don't want to call it…" Both men were hesitant to label male privilege and dominance, not necessarily because they didn't see it happening, but because of their concern of how outsiders viewed their field. This indicated their awareness of the stereotypes regarding the geosciences, and acknowledged their desire to distance themselves from the idea that the geosciences were a bad place for women.

Annie, who saw few problems for women graduate students in her department (noting only briefly there were a few advisors who weren't as fair to women), had some

concerns about being a woman in industry. She liked having the opportunity to intern for companies before accepting a job there, because it enabled her to get a feel for companies' environments. Annie had enjoyed her internship experiences and felt extremely well received by the companies for which she interned. For example, at one she was awarded the grand prize for her research in a contest held by the company among interns.

However, Annie had noticed that she had a better chance being offered an internship when the interviewer was a woman. This concerned her.

> One thing I've noticed too, is that the recruiters tend to recruit people like them, you know what I mean, which makes sense, right? They want people that they're going to work well with and people like them and so in general, I've found that I've had more success with companies that have sent female recruiters. And I don't know if that's kind of an underlying thing in industry. It is, I guess a little worrisome.

Annie felt that any potential gender bias she had noted might be overcome by an institutional commitment to gender equality: "They consciously try to be equal in promotion decisions and that sort of thing."

While Evan felt that men and women were treated equally within his department, he was aware of work/family balance concerns among women, especially women interested in academia. It was a topic he had discussed with his wife, a fellow geoscientist. He said that his wife had attended "a couple early career workshops that have been helpful to her," but so far, they hadn't come to a conclusion to what the best solution for their family would be.

Evan recognized that geology was "a classically-male dominated science," but felt the field was changing with the inclusion of a new, younger generation of geoscientists.

> I think especially geology there's sort of this stigma of old dirty geologists who like to play in the sand. And it's all 60-year-old men. Which is true in some departments and its true sort of a lot of places, but for the most part those people are retiring and they're being replaced by young, vibrant good scientists whether they're men or women, it doesn't matter. In all of the places where I've been to school as well as having been involved in departments at other universities that are hiring people, everybody's hiring the best the best professor regardless of gender, so people in the department talk about this sort of classically male dominated…

Evan felt that the problems people talked about in the geosciences were mostly a thing of the past.

Julia had attended a "women in geology presentation" at a Geological Society of America conference, and came away with the impression that the main problem in the industry was the "old guys," an impression similar to Evan's.

> Basically what I generally hear is that, yes, all the old people are old guys and some of them are kind of your stereotypical old oilmen who think that girls belong at home, but for the most part they really are quite happy to have girls there. Occasionally they're surprised by the fact that girls can do science, but that it doesn't really seem to be an issue. And a lot of companies are being very proactive about hiring more women, because they do have so many grumpy old men. And I did hear one person say that if you are a woman in the industry you kind of have to recognize the fact that you are surrounded by men, and, you know, get used to fart jokes and stuff like that. (laughs) And she said part of that's just the culture, especially if you're on a rig, and that's just kind of the way it is.

The presentation that Julia attended helped shape her attitude that the oil & gas industry is a man's world, and to succeed women need to accept that and do their best to fit in. Since a man's world was fart jokes, that didn't seem that bad. Another theme, evident in both Julia and Evan's interviews, is that if women wait it out, the "old guys" will retire and the industry will become a better place for women. I found a similar theme in a recruitment event I attended, held by a major:

> At the end of the presentation, she talked about how all the people in the industry were retiring, and there was a thirteen-year freeze during the eighties, so there are a bunch of sixty year olds, plus, "us." She is always getting e-mails about retirement parties. She can only say this because "Doris" isn't here anymore. She retired! And that's how she got the position of lead recruiter. So "you" need to come fill up the positions (Fieldnotes).

Although the recruiter did not comment on gender, she and her fellow recruiter were women.

Julia felt that she could deal with the male-dominated environment because she had been the only woman in a house of men during college and been an engineer major starting college (which is by far, the most male-dominated filed (NSF 2007)). Having "dealt with it before" was something I heard other women who had worked in male-

dominated spaces, say, too. It was worn almost as a badge of honor, as if to experience challenge made one stronger.

Presentations like the one Julia attended failed to make a deeper critique of the industry as being made by and for men, often assuming the only consequence of working in a male-dominated environment is "fart jokes." When the problems with the industry are construed this way, people are denied a feminist platform from which to change the industry *now*. Cindy launched a similar critique of these women's forums:

> I love going to all those things that Karen sets up, which is like "Women in the Oil Industry" and "Balancing your Career." And I don't think any of those are actually hard enough. They just talk basically about how they got to where they got and most of them are like (mocking tone) "Oh, it was just an accident. I didn't try very hard. It was just lucky, and I'm smart! And it happened to be where my husband was!"

Cindy launched the deepest critique of the geosciences and work organizations at large. Partially, Cindy's awareness of the biases in the workplace came from her own experiences working in the field of geosciences, like the time her subordinate at a field site refused to take direction from her because she was a woman. Although Cindy was not interested in having children of her own, she said, "I'm a huge advocate for women being able to have a family and not have to give up [their job]." I cite Cindy at length, because of the passionate and far-reaching nature of her critique:

> I think one of the biggest problems for women is that we've got the opportunities now, but society is still not opening up, holding up this other end of the stick, that we're having to give up to have the time to do this. And they're not providing childcare on-site! In my opinion,—I don't know if it makes me a pinko commie—, but any company over a certain size should provide on-site childcare. Period. And I don't even want children! But I'm pissed off that I've had friends that have had to give up their career when they had kids because once they commuted there and commuted back, their children were asleep, and they'd never get to see them and then they'd spend all their money on daycare. Then what's the point of having a job? They didn't get to see their kids and all their money got sucked up by daycare. So what the hell? And they just have to quit. And I think it's totally… Our society is supposedly this wonderful, progressive equality bullshit. And it's not. And I don't think enough women are angry enough about it. And I go to these little conferences, and forums, and talks, and no one is angry. I'm the only one who is angry. (laughs) I'm like, why are we still putting up with this? Or there's women who have very compromising husbands who really do support their career,

> so they've had to work their way up a male-oriented organization like the oil industry, but they've had a very—either their husband is very professional, too, and they get those kind of jobs where one job offer means that the company also tries to find a place for them. Which I also look down upon. I mean, I understand. "I only have a job, because you want my husband so bad." That makes me sick.

Cindy demands change to support women's ability to have children and to allow women to have successful careers on their own terms, not because they are connected to a desirable male candidate.

Bridget recognized that some organizations were better suited for balancing work and family-life (especially for women and men with children), while others were not, stating that "the person who has the baby is [not] the problem; the organization is the problem." However, instead of applying her zeal to spread opportunity to her fellow women classmates to the world of work, she concluded, "you don't necessarily have to make these battles your own personal battles." Rather she would look to work for a place where other women were already succeeding. In entering an organization not set up for women to succeed, "you're really creating a problem that you're going to have to change earlier."

While other women noted that work/family balance was a potential issue in their future, they did not apply a feminist critique to the organization of the workplace or gender relations that place primary responsibility for caring for children on women. Heather, for instance, felt she was too young to worry about the issues surrounding a work/family balance; she wanted to establish a career first, and *then* think about it.

> This is going to sound terrible. But at least for right now, cause I'm young enough, I'm kind of selfish, in that what I want to do I want to do before I put anybody else ahead of me. Where I am now, I definitely am not concerned with family, that kind of thing. I guess I would be kind of concerned about maybe a significant other like if that sort of thing were to develop. And then I would have to move somewhere. That could be an issue. And I guess that's part of family. But I don't plan on having children *anytime* soon and that kind of thing. And we plan and that doesn't always happen, but… So that's not a huge concern for me. I don't know, I'm, right now, wholly focused on doing everything I possibly can to reach my career goals that I probably have blinders on for everything else.

What is interesting here is that although Heather displays interest in pursuing a career,

and putting it before family, now, she anticipates coming second if she were to marry: "And then *I* would have to move somewhere." She also frames herself as being "selfish" for focusing on her career. Thus, even if Heather is the model of the "career women" seeking to get ahead and to achieve her work goals before focusing on the development of other areas of her life, she is still affected by the same cultural morays that cause women who choose work over family to feel "selfish" that women have been dealing with since second wave feminism opened the doors to the boardroom.

Ligia simply noted that the women who didn't leave the geosciences typically didn't have children, while male geoscientists often did. Rita, on the other hand, talked extensively about how being a woman has impacted her graduate school experience (typically, in ways she deemed negative). She also shared the difficulties she thought she'd face balancing children and a career and talked about the importance of working at a place that supported "being a mother and a scientist." However, as the interview came to a close, and I asked her for parting words, she responded:

> I don't think that there's any reason to talk to them [professors about changing the way women are treated], because it's not really going to change. If I had the opportunity to hire a 32-year-old guy or a 32-year-old girl, I would probably hire the guy cause I know I'm going lose a year on this woman if she decides to have a baby. She's not going to be producing, she's going to fall behind in her research and the literature, you know, a lot of it is not anybody's fault, is I guess is what I'm trying to say. A lot of it's just, you know, how it goes and trying to find a balance for each individual person is, I think, what's important.

Rita's interview shows how deeply engrained ideas of what an ideal worker should be are. Even after launching a critique of how gender negatively affects women's experiences in the geosciences, Rita, too was privileging the "disembodied worker."

Conclusion

In this chapter I explored graduate-level geoscientists' perceptions of the career options available to them, focusing mainly on two of the largest employers: academia and the oil & gas industry. I also explored how these perceptions were shaped, for example by graduate student networks which passed on information and stereotypes about oil & gas companies, through interaction with recruiters, and from personal assessments of their advisors' lives, and how gender played into assessments of career options.

One important theme that ran through many of the interviews was the importance of finding work-family balance, or for some, what might be more adequately called, work-personal life balance. In one of the most memorable moments in the interviews, Ryan explained the processes that shaped his decisions around choosing a career. While he wanted a job that used skills he had learned in undergrad and graduate school, because he didn't "want to spend all this time for nothing" his real focus was what he did outside of work. He paused, before continuing:

> What I really want, besides from the geology, because that is obviously what I'm studying, is a job that I like, and I can do for 30 or 40 hours a week, but one that affords me the opportunity to fulfill my life in ways outside of…to visit with friends and like doing things with friends, and I play music, and I want to have an opportunity to do all these things outside of what I actually study and do. So, I've never really wanted a job that I *love*, because then, if you love it too much, the job becomes your *life* and I don't want that.

In essence, Ryan had discovered the key to creating the ultimate disembodied worker: giving them interesting, meaningful work that could fulfill them in ways that outside activities can't compete.

Others recognized this, too, in their own ways: in their reluctance, for example, to be an academic. Being an academic wasn't a real "job" because for many of the students' professors seemed engaged in their work in ways not always typical to the way we dichotomize time between "work" and "fun" and "work" and "private time." To many students, then, there seemed to be reluctance to give up the line we draw in the sand to mark the hours of the day that are paid for and those that somehow mark an expression of who we are, what we choose to do in our "free time."

As summarized in Austin (2002), "graduate students experience several socialization processes simultaneously: socialization to the role of graduate student, socialization to the academic life and the profession, and socialization to a specific field or discipline." Students varied in their level of socialization into all three areas, and this, surely helped shape their decision of which workplace would be the best fit for them. Although students may have been happy and fulfilled in graduate school, and felt a sense of fit with their discipline, their disinterest in leading the so–called "academic life" turned them off from engaging in academia, or at least the most concentrated form of that which

marks the academic life: the R1 job.

In some ways, students' decisions to avoid the R1 route may have also served as a way to buffer them against, or avoid altogether, the likely disappointment of not receiving an R1 position. Although there is a strong demand for geoscientists, it is coming from areas other than academia, such as the oil & gas industry (Gonzales & Keane 2011). Over the past few decades the number of PhDs seeking academic jobs has increased remarkably, while the number of academic jobs have stagnated or declined, and the number of good academic jobs has dropped precipitously (Austin 2002). As Annie noted, faculty positions were in such demand that geoscience departments were able to offer one position to two geoscientists.

In this situation, the oil & gas industry came out looking like a better option for many. It is not that getting a job, and especially an internship, in the industry isn't competitive. Even though many of the students in my study came from geoscience programs that were highly regarded by the oil & gas industry, they didn't get all the interviews they applied for, nor all the internships for which they applied. Some students spoke of tight years, when they hadn't had a single offer on the table. The competitiveness that could be created over internship offers was evidenced in the male graduate students' degradation of a woman who had received numerous offers within one year, discussed in Chapter 4.

From the recruitment events I attended, it seemed as if oil & gas recruiters played themselves in opposition to academia, while drawing off aspects about college and graduate school that might be appealing. For example, at one event I attended, the students were dressed in business casual, while the speakers were dressed in matching polos. They spoke of the companies' "campuses." Their internships were designed primarily around work, but the number of opportunities for interns to socialize with each other and with young people in the company, at times made me feel like I was hearing a pitch for a summer camp or the introductory week before college when resident assistants traipse herd of closely bonded freshmen across campus. However, drawn in opposition to academia, industry was fast-paced, paid enough that one might think to buy a "BMW" when they received their paycheck, and was ready and waiting for young people to take over the reins. I am not suggesting that students did not filter these messages critically

when weighing their job options, only looking at the discourse they were provided.

Both men and women were essentially looking for the same thing in selecting a career: Evidence of people like them whom had made it work. However, the end result was qualitatively different. For some women, this meant narrowing their options to select fields or workplaces they deemed as woman and/or mother friendly. Rita, for example, decided to return to work for USGS, because of its family-friendly policies. While Rita was not upset with her decision—she liked USGS and felt it provided the opportunity for women to do high-quality, interesting work, and still be active mothers—on one level, she was giving up the chance to earn more money in industry or more prestige in academia, and on another level, by opting out of these fields, she was giving up the opportunity to disrupt or protest the gendered inequality that mark them.

Conclusion

The geosciences have achieved near gender-parity in graduate school enrollment. However, anecdotal information and several informal surveys suggest that women may leave the geoscience workforce at a much higher rate than men. While it is important to understand women's experiences once they enter the workforce, it is equally important to understand how gender impacts preparation for the geoscience workforce. Drawing on Etzkowitz, Kemelgor, and Uzzi (2000), I argued that women may be the victims of "cumulative disadvantage," that is, poor experiences may add up over time to impact women's outlook toward the field and decision to remain working as professional geoscientists. Drawing on three lines of theory, I argued that women may face three different types of disadvantage in graduate school in the geosciences. First, as a gendered organization (Acker 1990), graduate school demands a "disembodied student"—that is, a student who has no obligations outside his or her graduate program. Women who have or want spouses and/or children may experience discrimination and push factors from the field. Combining Acker's theory of gendered organizations with the work of Desmondra Rios (2010), I argue that the job of graduate student assumes that the position is filled by a white male. Along with Etzkowitz and colleagues (2000), I suggest that women may experience marginalization in graduate school, because they may not be aware of or follow the "unwritten rules" that contribute to success in graduate school. Third, I also acknowledge that some women might view the process of doing science as alienating.

For this study, I conducted interviews with 13 graduate students in elite geoscience programs. To gain a broader perspective into graduate students' experiences in the geosciences, I interviewed both men and women for this study. I examined how students developed an interest in the geosciences, their motivations for attending graduate school in the geosciences, and the process used to select a graduate program. Next, I examined students' experiences in graduate school, particularly the relationships students formed with other graduate students and advisors. I also explored the types of gender bias that impacted women graduate students in the geosciences. Finally, I examined students'

perceptions of a career in academia versus a career in the oil & gas industry, with an eye to how gender helped shape them.

For the most part, the graduate students I interviewed appeared content in graduate school. Both men and women seemed able to adapt rather readily to the (masculine) norms of graduate school, though some, like Ligia, did appear to struggle in doing so. Given how competitive gaining entry into an elite graduate program is, the selection process likely excluded those (men and) women who had not already proven their ability to fulfill the job requirements of a graduate student, through their success as undergraduate students and/or their previous work experience in the field.

However, female graduate students were caught in a double bind. Although they were expected to accommodate to the masculine norms of graduate school, they were also held to gendered expectations that they maintain appropriate shows of femininity. For example, Rita spoke of being held to the customs of the countries in which her field sites were located: This meant staying in after work and missing out on the socialization and networking opportunities her male colleagues enjoyed.

Similarly, most graduate students that I interviewed did not seem to experience a disconnect with the way science was practiced and their own goals and values. They enjoyed studying their respective topic areas and conducting research. Again, the selection process (both self-driven and institution-driven) into an elite institution, likely meant that persons for whom the masculine ways of producing science were alienating were unlikely to make it into the programs from which I interviewed graduate students, if they pursued the geosciences at all. However, Ligia, a woman, minority, and international student, did mention briefly the discomfort she felt with her department's emphasis on what she felt were narrow, technical-based questions and her own interest in research that took into consideration broader philosophical and ethical questions.

Gender bias did exist in graduate school in the geosciences, though the extent to which individual women perceived it as impacting their own graduate experiences varied. For example, Annie felt that she personally had not experienced gender discrimination but also acknowledged that there were several faculty members in the department known for their dismissal of female graduate students.

Evidence suggested that not all women geoscientists were aware of the extent to which gender bias may impact them both in graduate school and beyond. The most outspoken and informed women were those who had work experience in the geosciences prior to returning to school. For example, Cindy's poor experience in the geoscience workforce helped her to develop a feminist consciousness about the inequality faced by women in the geosciences.

Other women, however, felt that their gender would not hinder them, at least not too detrimentally, in the workforce. While respondents acknowledged that the geosciences had a reputation for being an unfriendly space for women, many felt that increased gender parity at the graduate school level and "the big crew change" (referring to the fact that younger geoscientists are rapidly replacing older geoscientists, who are retiring from the workforce en masse) was resolving, or had resolved, these issues. This message was promulgated through industry recruiters and, to some extent, networking and informational events for women.

While it certainly appears that women have far better opportunities in the geosciences than ever before, and especially since the original institutionalization of the geosciences in colleges and universities (Burek and Kohlbl-Ebert 2007), it is not yet time for women (or men who care about gender equality) to let down their guard. Working from the premise that women no longer face any challenges or barriers in the geosciences, or that all they'll need to deal with are "fart jokes," strips men and women of a feminist platform from which to identify and work towards reducing gender inequality.

Those that did recognize systematic gender bias against women in the geosciences, such as Bridget and Rita, have largely developed individual solutions to what are systematic problems, for example, seeking out organizations that are more women and mother-friendly. It is exactly well-informed and passionate people like Bridget and Rita, however, who are essential in a press for institutional change.

Another interesting finding was the emphasis that men (in addition to women) put on identifying a career path that would allow them to maintain a work-family balance. Since the industrial era men have proved themselves through their success in the public sphere (Kimmel 1994), placing less emphasis on their role as fathers (though slightly

more on their role as husbands, due to an increased focus on love, rather than family lineage for matchmaking) than in the pre-industrial era (Kimmel 2011). Over the past few decades, though, men have acknowledged an interest in spending more time with their families; however, as Kimmel puts it: "Men often say that they want to be involved fathers and spend quality time with their children. But rarely are they willing to make sacrifices in order to do it." (Kimmel 2011). In this case, however, men are taking concrete steps to identify careers that will enable them to have a fulfilling career and a fulfilling family life. For example, Daniel sought out speakers at his department to ask them about their ability and strategies to maintain work-family balance in their current careers.

Because this study is not longitudinal, I do not know if the men in this study will follow through and choose careers that are more family-friendly. However, it is important to note that *all* of the careers that graduate students in the geosciences were considering have typical work weeks of 40 hours a week or more and many require significant travel and fieldwork. Thus, interest in maintaining a work-life balance may run up against the reality of the job market. Although women have the cultural space to "opt out" of work to spend more time with their families, men, who primarily derive their self- and social-worth out of their marketplace interactions, can less readily access this option.

Several limitations to this study should be noted. While my interviews provided deep and varying insights into the experiences and perceptions of graduate students in elite geoscience programs, my findings may not be exhaustive for graduate students in the geosciences more generally. I anticipate that students at lower-ranked schools are unlikely to face the same pressures as students in elite programs. For example, they are unlikely to experience pressure to seek jobs at R1 institutions or to be recruited as heavily by the oil & gas industry.

In addition, more research needs to be conducted into the experiences of minority students and international students. While American born minorities are under-represented within graduate-level education in the geosciences, international students are relatively well represented in higher education in the field (Gonzales & Keane 2011). Information gathered from the two international students in my study as well as my fieldwork suggests that international students might face additional barriers in graduate

school, for example, they may have trouble finding funding, getting internships, or finding a job in the United States once they graduate, if they so wish to do so.

My research points to the need for a longitudinal study of students in the geosciences. By the time they get to graduate school, students whom have had poor experiences in the sciences have largely been weeded out. This likely explains why I found so few differences between men and women's experiences up to graduate school.

This thesis is part of a long line of research contributing to an understanding of women's experiences in the sciences. To the extent possible I drew on this research to illuminate the findings in my own work. The unique contribution of this work is to consider how gender operates in graduate school to orient women and men toward career options available to them as geoscientists, and their future career as professionals in the field. My research suggests that the geosciences have come a long way in admitting women into the field, at least at the graduate-level, and providing them access to many of the same opportunities men have. However, there is still much work to do. From both a practical and ethical standpoint, it is incumbent upon the field to retain women geoscientists, and to help change institutional structure so women can better balance the "home" and the "cave."

Appendices

Appendix A. Summary Characteristics of Sample

	Trait	N
Sex	Woman	7
	Man	6
Program	Terminal Masters	5
	PhD	8
Race	Caucasian	9
	Caucasian/Other	2
	Other	2
U.S. Citizen	Yes	11
	No	2
Age	20-25	2
	26-30	8
	31-35	3

Appendix B. Respondent Characteristics, Detailed

Participant	University	Program	Sex	Race	Age
Ron	State	MA	Man	Caucasian	26-30
Ligia	State	PhD	Woman	Other	26-30
Julia	State	MA	Woman	Caucasian	26-30
Annie	Midwest	PhD	Woman	Caucasian	26-30
Heather	Midwest	MA	Woman	Caucasian/Other	20-25
Ryan	Midwest	MA	Man	Caucasian	20-25
Daniel	Midwest	PhD	Man	Caucasian	31-35
Evan	Midwest	PhD	Man	Caucasian	26-30
Kevin	Southwestern	PhD	Man	White/Other	26-30
Milton	Southwestern	PhD	Man	Other	26-30
Rita	Southwestern	PhD	Woman	Caucasian	31-35
Bridget	Western	PhD	Woman	Caucasian	26-30
Cindy	Western	MA	Woman	Caucasian	31-35

Appendix C. Department Characteristics

University	Location	Ranking	Program size	Interviewee N
Midwest University	Midwest	High	50-100	5
State University	Southwest	Med. High	100-150	3
Southwestern University	Southwest	High	75-125	3
Western University	West	High	125-175	2

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